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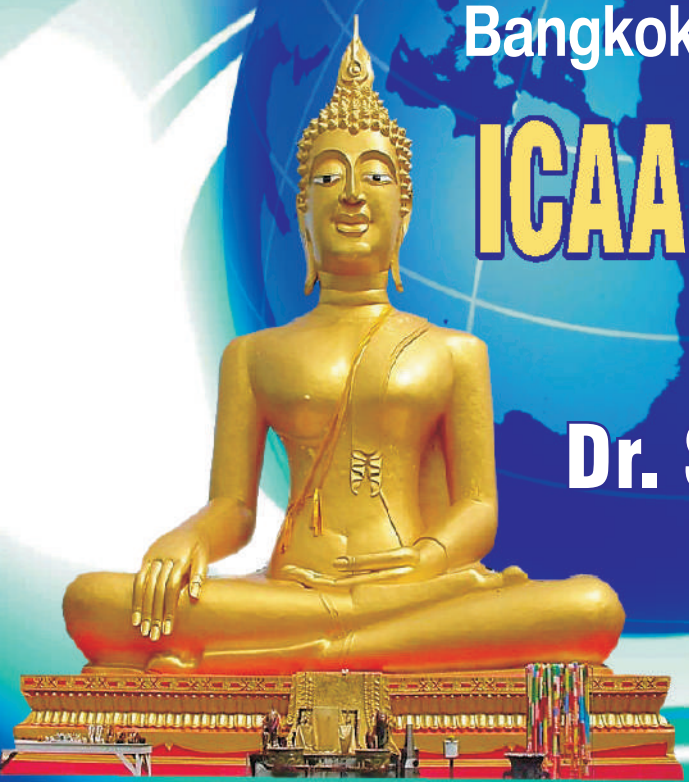
International Conference on

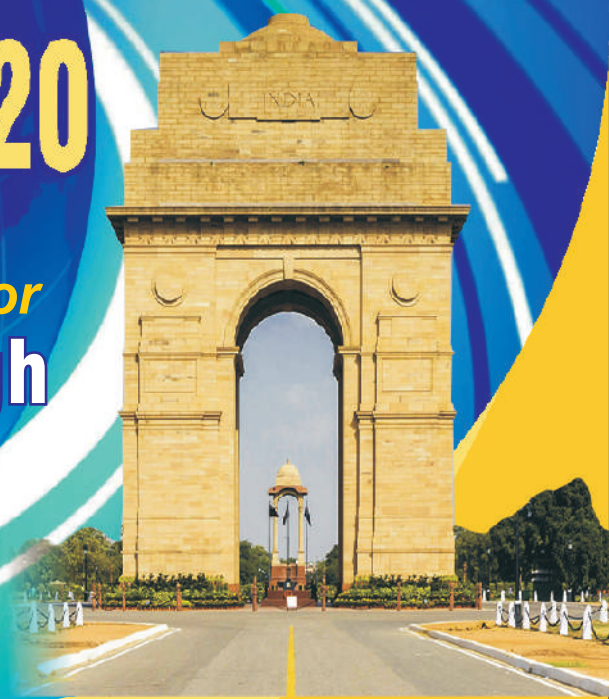
Innovative and Current Advances in Agriculture and Allied Sciences

27 January - 01 February, 2020

Venue : Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33
Bangkok 10400 Thailand



ICAAAS-2020



Chief Editor

Dr. S.P. Singh

Souvenir & Conference Book

Jointly Organized By

Society for Scientific Development in Agriculture & Technology, Meerut (U.P.) INDIA

&

Astha Foundation, Meerut (U.P.) INDIA

ISBN No : 978-93-88821-58-2

A Souvenir & Conference Book Brought out on the occasion of a One Week

International Conference on

Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)

27 Jan - 01 Feb, 2020

Venue : Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33 Bangkok 10400, Thailand

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Dr. S.P. Singh

Scientist Plant Breeding, CSAUAT-ARS, Kalai, Aligarh (U.P.) India

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Published By : Rama Publishing House, Meerut (U.P.) India

सत्यमेव जयते

नरेन्द्र सिंह तोमर
NARENDRA SINGH TOMAR

कृषि एवं किसान कल्याण,
ग्रामीण विकास और पंचायती राज मंत्री
भारत सरकार
कृषि भवन, नई दिल्ली

MINISTER OF AGRICULTURE & FARMERS WELFARE
RURAL DEVELOPMENT & PANCHAYATI RAJ
GOVERNMENT OF INDIA
KRISHI BHAWAN, NEW DELHI

MESSAGE

It gives me immense pleasure that the Society for Scientific Development in Agriculture and Technology, Meerut (UP) India & Astha Foundation, Meerut (U.P.) India are Jointly organizing a one week International Conference on "Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)" during 27 Jan - 01 Feb 2020 at Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33, Bangkok, Thailand.

I hope the issues pertaining to various aspects of science and technology and their dissemination to the end user will be deliberated and discussed by the delegates, at length, during the conference in order to come out with certain adoptable low-cost, location specific recommendations for the benefit of the people at global level.

I convey my best wishes for great success of the conference and complement to both the societies for organizing the event.

Narendra Singh Tomar

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कृष्ण पाल गुर्जर
Krishan Pal Gurjar

सत्यमेव जयते

सामाजिक न्याय और अधिकारिता राज्य मंत्री
भारत सरकार
MINISTER OF STATE FOR
SOCIAL JUSTICE & EMPOWERMENT
GOVERNMENT OF INDIA

MESSAGE

It is a great to welcome you all to the One Week **International Conference on Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)** which is being held during 27 Jan - 01 Feb, 2020 Jointly organized by Society for Scientific Development in Agriculture and Technology, Meerut (UP) India. and Astha Foundation, Meerut (UP) India.

India has undergone a series of ups and down in agriculture production and food security playing havoc in the year of abnormality. Food Security in India can be achieved by playing higher attention to such as climate change, integrated water management, use the advanced agricultural techniques and pricing etc. New technologies will be make it possible for sustainable agriculture.

I express my sincere thanks to the organizers for organize such kinds of International Conference to exchange the idea for the growth of Agriculture.

Krishan Pal Gurjar

डॉ0 संजीव कुमार बालियान
DR. SANJEEV KUMAR BALYAN

राज्य मंत्री
मत्स्यपालन, पशुपालन एवं डेयरी मंत्रालय
भारत सरकार
कृषि भवन, नई दिल्ली–110001
MINISTER OF STATE FOR FISHERIES,
ANIMAL HUSBANDRY & DAIRYING
DEPARTMENT OF ANIMAL HUSBANDRY & DAIRYING
GOVERNMENT OF INDIA
KRISHI BHAWAN, NEW DELHI–110001

MESSAGE

It gives me immense pleasure that the Society for Scientific Development in Agriculture and Technology, Meerut (UP) India & Astha Foundation, Meerut (U.P.) India are Jointly organizing A One Week International Conference on "Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)" during 27 Jan - 01 Feb 2020 at Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33, Bangkok, Thailand.

Role of Agriculture in sustaining food security and economic stability is well recognised. Agriculture has been always vulnerable to unfavourable weather events and climate conditions. Climate change has now become a big challenge in achieving food and nutritional security in India. I hope the deliberations of the conference will converge on formulation of a blue print on modern techniques of science and technology at global level.

I congratulate the organizers and the participants on this occasion and I wish the conference a great success.

(Dr. Sanjeev Kumar Balyan)

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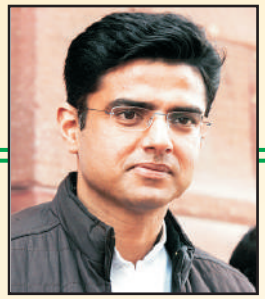
कार्यालय : कृषि भवन, नई दिल्ली–110 001 दूरभाष 011–23383727, 011–23383710 (फैक्स)

Sachin Pilot
Deputy Chief Minister



Rural Development & Panchayati Raj, PWD,
Science & Technology and Statistics Department
Government of Rajasthan,
Jaipur

MESSAGE

I am very glad to know that the Society for Scientific Development in Agriculture and Technology, Meerut (UP) India & Astha Foundation, Meerut (U.P.) India are Jointly organizing A One Week International Conference on "Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)" during 27 Jan - 01 Feb 2020 at Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33, Bangkok, Thailand.

While it is generally believed that creation of knowledge is the result of pursuit of scientific methodology, yet innovation is a multi disciplinary process connecting the arts and sciences. Human creativity does involve values, intentions, aesthetic judgments and personal consciousness. I wish the conference shall open new vistas for creation of knowledge for the welfare of the humanity.

I hope that the interactive sessions amongst scientists will be fruitful. I congratulate the organizing members and wish the conference a great success.

(Sachin Pilot)

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M S Swaminathan Research Foundation

Center for Research on Sustainable Agriculture and Rural Development

Third Cross Street, Taramani Institutional Area, Chennai - 600 113

M S Swaminathan

Member of Parliament (Rajya Sabha)

Emeritus Chairman, M S Swaminathan Research Foundation

MESSAGE

I am glad to know that Society for Scientific Development in Agriculture and Technology, Meerut (UP) India & Astha Foundation, Meerut (U.P.) India are organizing A One Week International Conference on "Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)" at Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33, Bangkok, Thailand during 27 Jan - 01 Feb, 2020.

The subject chosen is very relevant and timely to address the current agricultural scenario in the country and state as well. I hope that this conference will come out with viable researches for farming community.

I wish the conference all success.

sd-

M S Swaminathan

Tel: +91-44-2254 2790 / 2254 1229 / 2254 1698; Fax: +91-44 2254 1319

E-mail : founder@mssrf.res.in/msswami@vsnl.net

डा0 एस0 सोलोमन
कुलपति
Dr. S. Solomon
Vice Chancellor

चन्द्रशेखर आजाद कृषि एवं प्रौद्योगिक विश्वविद्यालय
कानपुर – 208 002, उत्तर प्रदेश, भारत
Chendra Shekhar Azad Unversity of Agriculture & Technology
Kanpur 208002, Uttar Pradesh, India

MESSAGE

Innovations can only have the answers to plateauing yield stagnation in crop productivity levels. With Challenges in several fronts as reduced land availability and increased demand for food production, crop production is being intensified through higher fertilizer inputs and cropping. The increase in production has to be achieved under conditions of declining and deteriorating land, soil and water resources and at the same time preserving the environmental quality. It will be indeed difficult to meet these daunting challenges only with the application of conventional techniques and tools, as no headway is being made through these approaches. To address the emerging challenges opportunities have to be identified to meet crop production and productivity targets so that the novel variability can be created and harnessed across the species and kingdoms. It is in this context, the One Week International Conference on **"Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)"** Jointly organized by **Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) India** and **Astha Foundation, Meerut (U.P.) India** during 27 Jan - 01 Feb, 2020 at Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33, Bangkok, Thailand.

The conference will provide a common platform for all the stake holders to share their Innovations/experiences and expertise to better understand the challenges posed by emerging problems in agriculture and to fine-tune future strategies/approaches for addressing such stresses in different areas of agriculture and allied sciences. I convey my greetings and best wishes to organizers and delegates for their joint venture for the success of these One Week International Conference.

(Sushil Solomon)
Vice Chancellor

इंदिरा गांधी कृषि विश्वविद्यालय
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डॉ. एस.के. पाटील
कुंलपति
Dr. S.K. Patil
Vice Chanlellor

MESSAGE

Agriculture in India is highly diversified and crops are grown in diversified environments viz., water logged to rainfed uplands, hums to deep water, high humid to arid temperatures and flood prone to drylands. Soils are so extraordinarily varied that there is hardly any type or texture of soils on which cultivation cannot be done viz. acid peaty soils of Kerala (pH3), highly alkaline soils (pH 8.5 and above) of Punjab, Haryana and Uttar Pradesh. Increasing use of inputs together with improved cultures and irrigation has contributed substantially to overall growth in crop production. However, recent concerns regarding decreasing conjunctive use of organic manures, imbalanced use of fertilizers and blanket fertilizer recommendations over large domains without considering variability in soil fertility have all contributed to discouraging impacts on crop production and on soil health, particularly in intensive crop systems. Furthermore, frequent occurrence of abiotic stresses such as drought and submergence has been identified as the key to the low productivity of rainfed ecosystems.

It is a matter of great pleasure to know that Society for Scientific Development in Agriculture and Technology, Meerut (UP) India and Astha Foundation, Meerut (UP) India are Jointly organizing A One Week International Conference on **"Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)"** during 27 Jan - 01 Feb, 2020 at Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33, Bangkok, Thailand

I wish the International Conference a grand success.

(S.K. Patil)

Mahatama Phule Krishi Vidyapeeth

Rahuri - 413 722, Dist. Ahmednagar, Maharashtra (India)

Dr. K.P. Vishwanatha
Vice Chancellor

MESSAGE

It is a matter of great pleasure to know that Society for Scientific Development in Agriculture and Technology, Meerut (UP) India and Astha Foundation, Meerut (UP) India are Jointly Organizing A One Week International Conference on **"Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)"** during 27 Jan - 01 Feb 2020 atHotel Ramada D'Ma, 1091/388 New Petchburi Road 33, Bangkok, Thailand.

Agriculture is no longer an activity for sustenance only it has to be considered as a commercial enterprise in which profitability and sustainability are both equally vital. Farming has to be technology driven with a clear cut focus on reducing cost of cultivation and enhancing productivity and quality of produce. It has to be knowledge based. Without application of science and technology in agriculture and allied fields, the sustainability would remain uncertain considering the challenges being faced by the Agriculture sector worsen by the climate change impacts. It requires a multi- pronged approach to manage natural resources sustainably, enhanced productivity link the production system to storage, processing & value addition and marketing in order to make the entire system, vibrant and employment oriented. I feel that in this conference, the learned delegates will deliberate on burring issues and challenges facing the farming community with emphasis on small and marginal farmers and come out with tangible suggestions. I hope that the outcome of the Conference will help in developing strategies and an action oriented road map to promote sustainable and profitable agriculture.

I wish the conference a grand success and congratulate the organizers for their judicious planning and hard work.

(K. P. Viswanatha)

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Phone : 08182-267000
Fax : 08182-298008

ಕೃಷಿ ಮತ್ತು ತೋಟಗಾರಿಕೆ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಶಿವಮೊಗ್ಗ
UNIVERSITY OF AGRICULTURAL AND HORTICULTURAL SCIENCES, SHIVAMOGGA

Dr. M.K. Naik
Ph.D (IARI), PDF (ICRISAT) FBA (USA) FPSI, FNABS
VICE CHANCELLOR

Savalanga Road, Shivamogga-577204
Karnataka, India

MESSAGE

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M.K.Naik
Vice Chancellor

बिरसा कृषि विश्वविद्यालय
BIRSA AGRICULTURAL UNIVERSITY
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Kanke, Ranchi - 834006, Jharkhand (India)

डॉ. आर. एस. कुरील
Dr. R.S. Kureel
कुलपति
Vice Chancellor

Message

It is a matter of great pleasure to know that Society for Scientific Development in Agriculture and Technology, Meerut (UP) India and Astha Foundation, Meerut (UP) India are Jointly organizing A One Week International Conference on **"Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)"** during 27 Jan - 01 Feb, 2020 at Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33, Bangkok, Thailand

We are the country with more than 50 percent of our population still dependent on agriculture. It is a challenging fact that even after one decade of twenty-first century. There are ample evidences available that relatively low productivity in our agriculture is due to suboptimal performance related to management aspects rather than low potential. Therefore, the developing countries like us, having optimal potential in the field of technology and services will take strong steps towards second green revolution. I am extremely confident that the discussion among professionals, exchange of ideas, issue and findings during the event will certainly make a far reaching impact on our agriculture system.

I am sure that this event will open new facets and dimensions to bring solutions of the alarming issues before scientific community working towards food security of India and Abroad.

I express my warm greetings on the occasion and extend my best wishes to the organizers.

Dr. R.S. Kureel

उत्तमा वृत्तिस्तु कृषिकर्मेव

स्वामी केशवानन्द राजस्थान कृषि विश्वविद्यालय
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प्रो. आर.पी. सिंह
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Message

Crop yield and growth has reached a plateau and no significant increase is being realized in productivity levels. With reduced land availability and increased demand for food production, crop production is being intensified through higher fertilizer inputs and cropping. Keeping in view the annual average population growth rate of ~1.5% and estimated per capita consumption of about 450 g per day, the demand for cereal crops is expected to increase to 40% by 2025. This projected demand can be met only if there is a steady increase in productivity and production. Further, the increase in production has to be achieved under conditions of declining and deteriorating land, soil and water resources and at the same time preserving the environmental quality. It will be indeed difficult to meet these daunting challenges only with the application of conventional techniques and tools, as no headway is being made through these approaches. Emerging challenges are plenty and new frontiers of combating these imposed challenges have to be identified to meet crop production and productivity targets so that the novel variability can be created and harnessed across the species and kingdoms.

It is in this context, the six days International Conference on "Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)" during 27 January – 01 February, 2020 at Hotal Ramada D'Ma, 1091/388 Petchburi Road 33 Bangkok 10400 Thailand. Being organized by the Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) India and Astha Foundation, Meerut (U.P.) India will be highly pertinent. The conference will provide a common platform for all the stake holders to share their Innovations/experiences and expertise to better understand the challenges posed by emerging problems in agriculture and to fine-tune future strategies/approaches for addressing such stresses in different areas of agriculture and allied sciences. I convey my greetings and best wishes to organizers, delegates and sponsors for their joint venture for the success of this One Week International Conference.

R.P.S.

(R.P. Singh)

National Academy of Agricultural Sciences

Prof. Anil Kumar Singh
Secretary

MESSAGE

It is a matter of great pleasure to know that Society for Scientific Development in Agriculture and Technology, Meerut (UP) India and Astha Foundation, Meerut (UP) India are Jointly organizing A One Week International Conference on **"Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)"** during 27 Jan - 01 Feb, 2020 at Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33, Bangkok, Thailand.

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I wish the conference a grand success and congratulate the organizers for their judicious planning and hard work.

(A.K.Singh)

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CONFERENCE CHAIRMAN

MESSAGE

Our earth provide the basis for food production. The interaction of different enterprises with different cultures in different climates results in the need for unique approaches to sustainable agricultural systems in each situation. The transition to systems that are both sustainable and sufficiently intense to support the increasing density of human population will be faster or slower depending on the resources available. The renewed recognition of the sustainable resource management for assuring food security and the fundamental role in climate change adaptation and mitigation has triggered numerous projects, initiatives and actions on a global scale. But fertile soils are limited and are increasingly under pressure by competing land uses for cropping, forestry, and pasture/rangeland but also for energy production, settlement and infrastructure, raw materials extraction, etc. Sustaining and feeding the growing population of the world and meeting their needs for biomass (energy), fibre, fodder and other products will be the guiding principles and drivers of future research thrusts on a global scale.

Agriculture in India is highly diversified and crops are grown in diversified environments viz., water logged to rainfed uplands, jhums to deep water, high humid to arid temperatures and flood prone to dry lands. Frequent occurrence of abiotic stresses such as drought and submergence has been identified as the key to the low productivity of rainfed ecosystems. Value addition is the key coupled with rapid technological interventions will upscale the productivity of the small and marginal farmer's of India. It is not recent, significant changes are already happening even in the parched, hungry, degraded lands. The **Society for Scientific Development in Agriculture and Technology, Meerut (UP) India** and **Astha Foundation, Meerut (UP) India** has played significant role in providing suitable forum for exchange of ideas, encouraging research and disseminating knowledge of sustainable agriculture and allied sciences to researchers.

Climate regulation as well as biodiversity conservation and other cultural services, increasing land use changes are threatening this resource and urgent action is needed to reverse this trend if we want to assure the necessary food production for future generations.

A One Week International Conference on **"Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2020)"** during 27 Jan - 01 Feb, 2020 at **Hotel Ramada D'Ma, 1091/388 New Petchburi Road 33, Bangkok 10400 Thailand** and the thematic areas chosen for the conference will be very useful for the researchers, development agencies and farmers of the country to understand the practical problems in the agricultural development of our country. Scientists have been at the forefront of our agricultural development in past. They are required to play still more critical role in ensuring sustainable agriculture development. I am sure that conference will address various aspects related to increasing productivity and food & nutritional security. Technologies have helped wipe out malnutrition and hunger and reinvigorating the innovations will spearhead path. I am sure that the outcome of this conference would be very meaningful and will be of immense use for scientists, extension workers and farmers.

I welcome all the delegates at Bangkok, Thailand and wish for a fruitful stay.

S.P. SINGH
Organizing Chairman, ICAAAS-2020
Scientist Plant Breeding, CSAUAT-ARS, Kalai, Aligarh (UP) India

CONTENTS

Lead Papers/ Invited Papers

INNOVATIVE AND CURRENT ADVANCES IN AGRICULTURE AND ALLIED SCIENCES (ICAAAS-2020)

S.P. Singh[1], C.L. Maurya[1], S.S. Gaurav[2], Brajendra[3], J.B. Singh[4], B.V. Tembhurne[5], Vijay Kr. Kurnalliker[5], Y.K. Singh[1], Anil Kumar[6], P.B. Singh[7] and S.C. Gaur[8]

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[2]*Deptt. of Genetics and Plant Breeding, Ch. Charan Singh University, Meerut (U.P.) India*
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[4]*ICAR-IARI Regional Station, Indore (M.P.) India*
[5]*University of Agricultural Sciences, Raichur, Karnataka, India*
[6]*Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India*
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[8]*Baba Raghav Das Post Graudate College, Deoria (U.P.) India*

Agriculture plays a pivotal role in the Indian economy with over 58 *per cent* of rural households depending on agriculture as their prime means of livelihood. We are the country with more than 50 *per cent* of our population still dependent on agriculture. Human population of India has increased to 1210.2 million at a growth rate of 1.76 *per cent* in 2011 over 2001 (1028.7 million) and is estimated to increase further to 1530 million by 2030 (Census of India, 2011). On the other hand, our national food grain production for past 3-4 years is hovering around 234 million tonnes. This means, per capita food grain production is only about 193 kg per year. India is facing the challenge to achieve sustainable food security with shrinking land resources by producing an additional 50 million tonnes of food to meet the requirement of the prognosticated population of 1,000 million in the country.

Present and anticipated global food demands necessitate a significant increase in crop productivity in marginal farmlands. Biotic and abiotic stresses are major limiting factors for plant growth, development and crop productivity. Although every plant has some degree of innate tolerance and/or resistance to such stresses but for a successful crop there is need to improve the resistance levels of these crop plants to keep pace with the future food demands. Before the introduction of fertilizer responsive high yielding varieties (HYVs) in mid sixties, indigenous varieties of wheat, rice and maize were grown as rainfed or partially irrigated and generally with little fertilizer input. The low level of yields resulted in persistent food shortages in the country. Intensive agriculture, which implies harnessing of soil and water resources, genetic potential of plant and other inputs in a large measures, that has taken firm roots in the irrigated areas of India has no doubt succeeded in getting the country out of the "food trap". A 'ship to mouth' existence of the early fifties has been transformed into one of "farm to ship" reality. The country is now boasting of an enviable buffer stock of 50 million tonnes food grains and quantum jumps in productivity and production of wheat and rice. The input intensive modern agriculture, which has succeeded in ushering in an era of self-sufficiency in food grain production, has also brought in several environmental problems.

There are ample evidences available that relatively low productivity in our agriculture is due to suboptimal performance related to management aspects rather than low potential. Therefore, the developing countries like us, having optimal potential in the field of technology and services will take strong steps towards second green revolution. Global climate change with predicted 1.5 - 3.8^{0}C increases in temperature by 2100 has to cause heat stress to create threats to agricultural production through high temperature and other abiotic stresses are clearly limiting factors for crops cultivated on marginal lands, crop productivity far and wide is often at the mercy of random environmental fluctuation. The unfavourable effects of heat stress can be mitigated by developing crop plants with improved thermo-tolerance using an assortment of genetic approaches. Acquiring thermo-tolerance is a lively progression by which considerable amount of plants resources are diverted to structural and functional maintenance to escape damaged caused by heat stress.

Investing in agriculture is one of the most effective ways of promoting agricultural productivity, reducing poverty and enhancing environmental sustainability. Making the transition to sustainable agriculture will not be possible without significant new investment to protect and enhance the efficiency of natural resource use and to reduce waste at all stages of production, processing and consumption. Fighting rural poverty has become the overriding priority in the new millennium. Our agricultural scientists and technologists have to work for doubling the

productivity of the available land under cultivation. While doing so, utmost care would have to be taken for various environmental and people related aspects leading to sustainable development. In recent years, enormous progress has been made in developing agriculture technology, cultivation and trade throughout the world. India is one of the richest countries in the world known for its biodiversity and natural resources. The green revolution helped in enhancement of crop quality and increases in production to a great extent. With the rapid industrialization and urbanization due to increase in population, the burden on natural resources is increasing apart from the environmental pollution. It is a matter of pride the scientific fraternity is taking initiatives to meet the challenges of degradation of land and water resources, loss of plant diversity due to the climatic changes and environmental pollution through continuous innovation, research and development.

Innovations can only have the answers to plateauing yield stagnation in crop productivity levels. With Challenges in several fronts as reduced land availability and increased demand for food production, crop production is being intensified through higher fertilizer inputs and cropping. The increase in production has to be achieved under conditions of declining and deteriorating land, soil and water resources and at the same time preserving the environmental quality. It will be indeed difficult to meet these daunting challenges only with the application of conventional techniques and tools, as no headway is being made through these approaches. To address the emerging challenges opportunities have to be identified to meet crop production and productivity targets so that the novel variability can be created and harnessed across the species and kingdoms. Agriculture plays an important role to meet food and development needs of the Indian population and also as a source of increasing national economy through trade. New Technologies are anticipated to play a major role in meeting nation's food security and in achieving Sustainable Development Goals of UN7 (for example- Goal 2: End Hunger, Achieve Food Security and Improve Nutrition, and Promote Sustainable Agriculture).

Innovations led development-Innovation-decision definition

Innovations – It is an idea, which is new one supposed to be adopted by the intended clientele. It may not always hold objectivity due to lapse of time since its discovery. According to Rogers (1983, 1995) the innovation – decision process is the process through which an individual or any decision making unit passes from first knowledge of an innovation, to forming an attitude towards the innovation, to a decision to adopt or reject, to implementation and use of the new idea, and to confirmation of this decision. This process consists of a series of actions and choices over time through which an individual or an organization evaluates a new idea and decides whether or not to incorporate the new idea into the ongoing system. This behaviour consists essentially of dealing with the uncertainty that is inherently involved in deciding about a new alternative to those previously in existence. The perceived newness of an innovation, and the uncertainty associated with this newness, is a distinctive aspect of innovation-decision making, compared to other types of decision making.

Innovation – decision process conceptualized to have five stages.

1. Knowledge 2. Persuasion 3. Decision 4. Implementation 5. Confirmation

Re-invention is defined as the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. Re-invention often is beneficial to the adopters of an innovation. Flexibility in the process of adopting an innovation may reduce mistakes and encourage customization of the innovation to fit it more appropriately to local situations or changing conditions. As a result of reinvention, an innovation may be more appropriate in matching an adopter's pre-existing problems and more responsive to new problems that arise during the innovation-decision process. Recognition of the existence of Re-invention brings into focus a different view of adoption behaviour – instead of simply accepting or rejecting an innovation as a fixed idea, potential adopters on many occasions are active participants in the adoption and diffusion process, to give their own unique meaning to the innovation as it is applied in their local context. Adoption of an innovation is thus a process of social construction.

In a very short span of time, Genome Editing (GEd) Technology has demonstrated its potential applications in a wide range of sectors covering human and animal health, food, agriculture, microbial biotechnology, bio-economy, etc. These potential applications include, but are not limited to, improved crop protection and livestock breeding, improved animal welfare, modification of animal donors for xenotransplantation, products of

microbial biotechnology, gene- and cell-based therapies to control diseases and prevent the inheritance of disease traits, control of vector-borne diseases such as Malaria, Dengue, Chikungunya, etc, biofuels, pharmaceuticals, and other high-value chemicals. Like with all new technologies, GEd technologies have dual-use potential and therefore involve both safety & security issues. Biotechnology offers safe and sustainable solutions to many environmental challenges. It is, therefore, envisioned that genome editing holds many promises to improve environmental quality as well as the quality of life and related services. The genome editing technologies offer solutions to address several issues related to Human & Animal Welfare and Protection of Environment. The Genome Editing Technology offers to increase yield and productivity of agricultural crops to meet constantly increasing demand for food and food security optimally by protecting them from various biotic and abiotic stresses and various other traits. India is a fisheries giant with a total catch of about 3 million metric tons annually placing India among the world's top 10 fishing nations. India's livestock sector is also one of the largest in the world including broad spectrum of native breeds of cattle, buffalo, goats, sheep, swine, equine, camel and poultry with merits of adaptability to climate and nutrition, and resistance to diseases and stress. The national targets for production of livestock and poultry products are 61% for milk, 76% for meat, 91% for fish, and 169% for eggs by the year 2020 over the base year TE 1999. The production potential in livestock is not realized fully because of constraints related to feeding, breeding, health, etc. Frequent outbreaks of diseases like FMD, BQ, PPR, Brucellosis, Swine fever, and Avian Influenza, etc. continue to reduce productivity and production.

Nutritional genomics is a new and promising science area which can broadly be defined as the application of high throughput genomics (transcriptomics, proteomics, metabolomics/metabonomics) and functional genomic technologies to the study of nutritional sciences and food technology. The combination of genomics and molecular biology has created a new way for scientists to generate plant varieties, one that offers wider functional scope and greater precision than conventional plant breeding methods.

Multiple biotic and abiotic environmental stress factors affect negatively various aspects of plant growth, development, and crop productivity. Plants, as sessile organisms, have developed, in the course of their evolution, efficient strategies of response to avoid, tolerate, or adapt to different types of stress situations. The diverse stress factors that plants have to face often activate similar cell signalling pathways and cellular responses, such as the production of stress proteins, up regulation of the antioxidant machinery, and accumulation of compatible solutes. Stress can be understood as a stimulus or influence that is outside the normal range of homeostatic control in a given organism: if a stress tolerance is exceeded, mechanisms are activated at molecular, biochemical, physiological, and morphological levels; once stress is controlled, a new physiological state is established, and homeostasis is re-established. When the stress is retired, the plant may return to the original state or to a new physiological situation.

Abiotic stresses remain the greatest constraint to crop production. Worldwide, it has been estimated that approximately 70% of yield reduction is the direct result of abiotic stresses. Transgenic approaches are one of the many tools available for modern plant improvement programs. Gene discovery and functional genomics projects have revealed multitudinous mechanisms and gene families, which confer improved productivity and adaptation to abiotic stresses. These gene families can be manipulated into novel combinations, expressed ectopically, or transferred to species in which they do not naturally occur or vary. Hence, the ability to transform the major crop species with genes from any biological source is an extremely powerful tool for molecular plant breeding. Transgenic plants can be used as sources of new cultivars and they are also extremely useful as proof-of-concept tools to dissect and characterize the activity and interplay of gene networks for abiotic stress resistance.

Swaminathan D. (1998) stated that technology, capacity building, and application for sustainable rural development could be more fruitful, if the exercise is undertaken through a partnership effort among the universities, engineering institution, rural and development labs, national institutions, agricultural research centres, NGOs, government departments and industries. The actual partnership may be determined by the local situations. The corporate sector can play an effective role in discharging its social responsibility in this partnership. This role is in addition to its industrial activity in the rural areas. Similarly, the professional and scientific expertise of the professional bodies and scientific academics could be fully utilised for the rural development activity.

This is where the mobile technology which over the year have become the integral part of business world and have multiplied the working efficiency in terms of real time communication, information and data sharing, having virtual presence and reach. The fact that with minimum infrastructure availability at the individual level mobile phones have the capability to connect any individual with the entire world on a click of button makes it a powerful tool to have access to desired information. In the 21st century, Information, Communication and Technology (ICT) are the most powerful *'enabler'* to provide a variety of inputs for rapid development of rural areas. The ICT could be effective tools for rural extension by the government and non-governmental organizations to effectively disseminate Information Resource. For the development, *Information Resource [IR]* is the vital input as that could increase the accessibility of any other resources - like financial, human, physical, technology and etc. The sustainable rural development can make a powerful contribution to fulfil - the poverty reduction, growth with equity, food security and effective natural resource management. There is a growing emphasis on development of rural economy for enhancing the livelihood of the rural people.

A systematic review of the factors responsible for decrease in availability of the natural resources, loss of bio diversity, increase in environmental pollution, climatic changes, decline in factor productivity and operational holdings and widening gap between rich and poor are threatening our food security and health. In recent years, enormous progress has been made in developing agriculture technologies, cultivation and trade through out the world. Making the transition from sustainable agriculture to sustainable empowerment will not be possible without significant new investment in protecting and enhancing the efficiency of production, processing and marketing personnel to embrace and share a diverse range of basic studies, techniques and experiences. In this context, deliberations in the international conference by eminent and galaxy of speakers of several innovative and current advances in agriculture and allied sciences will open new vistas in addressing all the issues.

AGROFORESTRY : A SEMI-NATURAL FARMING ALTERNATIVE TO CONVENTIONAL FARMING

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Abstract

Conventional agriculture through improved technology and higher use of inputs substantially increased the productivity as well as production and has almost eliminated hunger in the world. However, conventional agriculture being exploitative in nature is leading to degradation of ecosystem in most situations and this coupled with climate change is affecting the livelihood security of the rural poor who are directly dependent on the ecosystem. Therefore, to tackle these challenges different approaches such as precision agriculture, conservation agriculture, organic/bio-dynamic farming, natural farming etc. are being tested but these approaches also do entail with a few constraints. Agroforestry land use system where trees and shrubs are being intentionally grown along with crops on the same unit of land is considered to be one best natural resource management and climate resilient strategy. Hence, in the paper the role of agroforestry system in achieving the sustainability and building resilience to changing climate in production system is discussed. The study revealed that agroforestry could help to achieve the goals of social, economical and ecological sustainability through diversified products, employment generation, enhanced soil fertility, efficiency of natural resources and biodiversity and creation of microclimate to cope with changing climate and mitigating it through carbon sequestration.

Key words : *Ecosystem degradation, agroforestry, forestry, microclimate, climate change*

INTRODUCTION

Unprecedented technological advances in agriculture helped to meet the global demand of food and fiber of large population. However, the modern agriculture dominated with high input use and monoculture made us to revisit traditional practices due to increased soil degradation, decline in biodiversity and water quality, deforestation, environmental pollution, and in some instances even declined productivity and farm income (Keating *et al.*, 2010; Flynn *et al.*, 2009). Modern agriculture is not just most vulnerable to climate change but is it also one of the elements for climate change because of higher usage of synthetic fertilizers and fossil fuels, and unscientific management (Le Quere *et al.*, 2009). Today agriculture is contributing around 14 per cent of the total GHGs emission responsible for climate change (IPCC, 2007). That apart, the use of higher and unscientific use of inputs in agriculture reduced the level of income of the farmer due to higher cost of cultivation which is consequently leading to poor health and living standards of farming community in general (Ditt *et al.*, 2001; Munkel 2000). In all, agriculture which is major livelihood source of around 40-50 per cent of the global population especially among under developed and developing countries is under threat (UNEP 2009).

Presently, the major challenges of agriculture are higher production and its sustainability. It is estimated that the agriculture production has to be doubled by 2050 to meet the galloping global population which is expected to reach 9 billion plus. Already, substantial area is under agriculture which accounts around 40 per cent on global scale (Foley *et al.*, 2011). Hence, there is no opportunity to increase area under agriculture; therefore, increase in production has to come from increase in the productivity without endangering the ecosystem. This has given impetuous to think of alternative farming systems which help in better management of natural resources, sustainable production and offer resilience to climate change.

The approaches being tested worldwide include organic farming, biodynamic farming, conservation agriculture, precision agriculture, natural farming etc. Among these approaches some focused on reduction or precise use of inputs e.g. precision agriculture or conservation agriculture while others have given importance on the efficient use of natural resources and non/limited usage of synthetic inputs as in organic, biodynamic or natural farming. Recently a few approaches are evolved as mitigation and adoption strategy to climate change while other approaches address the health issues or environment. However, all these approaches have one or a few constraints to practice them on the field scale. For instance practice of organic farming requires huge amount of organic

resources of which is a question. In this backdrop agroforestry is considered as one potent system which can address the issues of natural resource management and climate change.

Agroforestry is a land use system where farmers deliberately retain or grow woody perennials in combination with the field crops and/or livestock on the same unit of land management either alternatively or at the same time to get diversified products to meet their basic requirement such as fuel wood, timber, fodder and food (Nair, 1985, Chittapur *et al.,* 2017). Besides, tree based land use systems offer several ecosystem services which benefit the agricultural practices through improvement in soil fertility, soil and water conservation, enhancement of water quality, carbon sequestration and biodiversity conservation (Jose 2009, Chittapur and Patil 2017).

In the context of global climate change, agroforestry is an effective approach to strengthen resilience of farmers through crop and income diversification, soil and water conservation and efficient nutrient cycling and conservation (Lasco and Pulhin 2009). It counters the adverse impact of climate change through synergetic action of adoption and mitigation (Verchot *et al.,* 2007) and, therefore, it was considered as the clean development mechanism (CDM) under the Kyoto Protocol. Agroforestry mimics the natural vegetation system to some extent and, hence it is considered to be the one of the best natural resource management strategies which help in achieving the goals of sustainability.

Agroforestry is an age old practice, indeed as old as civilization and these systems were considered to be bridge between nomadic life and permanent settlement e.g. shifting cultivation. Even in permanent settlement also farmers used to retain trees on farms to get ecological and economical benefits. Thus, agroforestry is a traditional method comprising variety of species and planting pattern within every agro-ecological condition at regional and farm levels, encompassing different farm management strategies depending on economic condition of the farmer, availability of land, etc. (Giller *et al*., 2006). Trees species selected are often designed to meet the multiple and diverse needs mainly the utility, economical product, compatibility and adoptability of species. Therefore, different kinds of agroforestry systems are practiced in different parts of the globe.

Traditionally most preferred agroforestry system under rainfed ecosystem is scattered planting which is also called as parkland system. Farmers prefer the trees on the bunds and farm boundaries with varying density of 15 to 40 trees per hectare in some instances (Doddabasava, 2017). The indigenous systems involving many different tree species were reported from many parts of the tropical countries of the world. *Faidherbia albida* in semi arid tropics in Westen Africa (Vandenbelt 1992), *Vitellaria paradoxa* and *Parkia biglobosa* in semiarid sub–Saharan Africa (Bremen and Kessler, 1995) and *Prosopis cineraria* with millets in Rajsthan (Tejwan, 1994) are some proven species.

Mechanisms of Sustainability

Income and employment : Diverse outputs from agroforestry system such as timber, fuel wood, fertilizer, fodder, food and other non timber forest products enhance the income level of the farmer directly. Further, revenue spreads into short, medium and long terms and also reduces the risk of failure of income (Gold *et al.,* 2006). That apart, agroforestry also generates sustainable employment to the farming community. Further, agroforestry provides livelihood opportunities in of subsidiary enterprises such as lac, apiculture, sericulture etc. apart from gum, resin and even medicines from some special tree species.

The level of income is also increased by reducing the cost of cultivation by lesser use of synthetic fertilizer or by enhancing the productivity of the field crop through enhanced, pollination, soil fertility, more efficient use of resources and creation of favourable microclimate. Thus, the livelihood of farmer is improved through diversified income from tree and enhanced productivity of the crop. Some of the studies indicated higher benefit cost ratio and land equivalent ratio in agroforestry systems (Sanchez *et al.,* 1997, Chittapur *et al*., 2017). Intercropping maize with coppicing legumes, for example, *G. sepium, Leucaena leucocephala* and *Calliandra calothyrsus* increased yields continuously for several years after establishment (Sanchez *et al.,* 1997; Garrity *et al.*, 2010). Analysis over a 5-year cycle indicated increased net profit from unfertilized maize to the tune of US$ 130 ha^{-1} compared to US$ 269 and US$ 309 ha^{-1} for maize intercropped with *Gliricidia* or in rotation with *Sesbania*, respectively. Further, benefit:cost ratios ranged from 2.77 to 3.13 for green fertilizer technologies, in contrast to 2.65 for subsidized fertilizers and 2.01 for non-fertilized fields (Ajayi *et al*., 2009).

Soil fertility : Sustainability of agriculture depends on the fertility of the soil. Continuous cropping without leaving the land fallow for restoring the fertility that too in the absence of adequate manuring leads to the decrease in the productivity. While, application of synthetic fertilizer is an option to increase the productivity, exuberating prices increase the cost of cultivation and moreover it causes pollution of ground water. Hence, maintenance and enhancement of soil fertility is important to achieve food security and environmental stability which needs to be addressed through appropriate site specific management practices. Among the land management practices agroforestry seems to be more promising in enhancing the soil fertility through the constant addition of organic matter, reduced nutrient leaching, more efficient nutrient cycling and reduced soil erosion According to Sanchez *et al*. (1997) there are four ways through which trees can contribute to the improved nutrient supply - increased nutrient inputs to the soil, enhanced internal cycling, decreased nutrient losses from the soil, and environmental benefits (Table-1).

Table-1 : Soil fertility enhancement in multifunctional agroforestry systems in India.

Region	Challenge	Changes observed due to Agroforestry
Himalaya (Kurukshetra)	Improvement of sodic soils	Increase in microbial biomass, tree biomass and soil carbon:enhanced nitrogen availability
Himalaya	Restoration of abandoned agricultural sites	Biomass accumulation (3.9 t/ha in agroforests compared to 1.1 t/ha in degraded forest) improvement in soil physic-chemical properties; carbon sequestration
Western Himalaya	Reducing soil and water loss in agroecosystems in steep slopes	Contour-tree-rows (hedge rows), reduced run-off and soil loss by 40 and 48 % respectively (in comparison to 344 mm run-off, 39 Mg/ha soil loss per year under 1000 mm rainfall conditions)
Sikkim Himalaya	Enhancing litter production and soil nutrient dynamics	Nitrogen fixing trees increase N and P cycling through increased production of litter and influence greater release of N and P, nitrogen fixing species help in marinating soil organic matter, with higher mineralization rates in agroforestry systems
Indo-Gangetic plains (UP)	Biomass production and nutrient dynamics in nutrient deficient and toxic soils	Biomass production (49 t/ha per decade)
Himalaya (Meghalaya)	Enhancing tree survival and crop yield	Crop yield did not decrease in proximity of *Albizzia* trees
Western India (Karnal)	Improvement of soil fertility of moderate alkalinesoils	Microbial biomass C which was lower in rice-berseem crop (109.12 g/g soil); soil carbon increased by 11-52% due to integration of trees and crops
Western India (Rajasthan)	Compatibility of trees and crops	Density of 417 trees per ha was found ideal for cropping with pulses
Central India (Raipur)	Biomass production in N and P stressed soils	*Azadiractha indica* trees were found to produce biomass in depleted soils
Central India	Soil improvement	Decline in proportion of soil sand particles, increase in soil organic C, N P and mineral N
Southern India (AP)	Optimality of fertilizer use	
Southern India (Kerala)	Growing commercial crops and trees	Ginger in interspaces of *Ailanthus triphysa* (2500 trees/ha) helps in getting better rhizome of the former compared to sole cropping

Efficient use of natural resources : Soil is considered to be non renewable resources because the formation of an inch of soil requires more than 1000 years. However, soil erosion has become an acute problem across the globe. The rate of soil erosion is much higher than natural soil formation and the rate of erosion was estimated to be in the range of 6 to 16 tonnes per hectare per year. However, Agroforestry systems having permanent cover play an

important role in reducing the soil erosion and restoring the land degradation by improved rate of infiltration, reduced runoff and holding of soil through their deep rooted system. The reduction in erosion also reduces the loss of nutrients from the system. The studies indicated reduced soil erosion and loss of nutrients in agroforestry systems compared to control (Penka *et al*., 2012).

Table-2 : Reduction (%) in sediment and nutrients loss with surface runoff in agroforestry buffer strips.

System	Slope %	Sediment	Nutrients					References
			TN	NH_4-**N**	NO_3-**N**	TP	PO_4-**P**	
G	1-2	19	21	ND	24	8	ND	Udawatta *et al.*, 2002
G	1	94-100	ND	100	100	ND	100	Schoonover *et al.*, 2005, 2006
G	5	95	80	ND	62	78	58	Lee *et al.*, 2003
G/W	1-2	0	20	ND	37	17	ND	Udawatta *et al.*, 2002
G/W	5	97	94	ND	85	91	80	Lee *et al.*, 2003
G/W	4-15	80	50	20-50	50-90	60	50	Daniels and Gilliam 1996
F	1	76-86	ND	68	97	ND	78	Schoonover *et al.*, 2005, 2006

Note : TN = total nitrogen, NH_4-N = ammonium nitrogen, NO_3-N = nitrate nitrogen, TP = total phosphorus, PO_4-P = phosphate phosphorus, G = grass strip, G/W = grass/woody strip, F = Forest buffer, ND = not determined.

There are several mechanisms whereby agroforestry may use available water more effectively than the annual crops. Firstly, unlike in annual systems where the land lies bare for extended periods, agroforestry systems with a perennial tree component can make use of the water remaining in the soil after harvest and the rainfall received outside the crop season. Secondly, agroforestry increases the productivity of rain water by capturing a larger proportion of the annual rainfall by reducing the runoff and by using the water stored in deep layers. Thirdly, the changes in microclimate (lower air temperature, wind speed and saturation deficit of crops) reduce the evaporative demand and make more water available for transpiration. In continuous maize cropping and improved fallow system in Malawi, Africa higher maize yield and rainfall use efficiency were observed in improved fallow system with *Sesbania sesben* as compared to the continuous maize cropping system (Mbow *et al.*, 2014). In another a study, out of 1106 mm rainfall, runoff noticed was 782, 372 and 66 mm in bare soil, grass land and tree + grass cover, respectively and the remaining infiltrated in to the soil profile indicating the positive interactions of tree + crops in water conservation (Mishra *et al.*, 1979).

Favourable microclimate : Monteith *et al.*, 1991, reported that trees on farm bring about favourable changes in the microclimatic conditions by influencing radiation flux, air temperature, wind speed, saturation deficit of under storey crops all of which will have a significant impact on modifying the rate and duration of photosynthesis and subsequent plant growth, transpiration, and soil water use.

For instance soil, temperature under the baobab and *Acacia tortilis* trees in the semi-arid regions of Kenya at 5-10 cm depth were 6 °C lower than those recorded in open areas (Belsky *et al*., 1993). In the Sahel, where soil temperatures often go beyond 50° to 60 °C, a major constraint to establish a good crop, *Faidherbia* trees lowered soil temperature at 2cm depth by 5° to 10°C depending on the movement of shade (Vandenbeldt and Williams, 1992). Significantly higher yield of both groundnut and sesame were recorded in alley cropping system as compared to the sole cropping system in the semi desert system in northern Sudan (Haider and Adam, 2008). Shelterbelts and wind breaks are extensively used agroforestry systems to reduce specifically wind velocity and soil erosion which also modify the microclimate through reduced wind velocity and soil moisture evaporation, and with proper design of planting and management of these systems protection on lee word side could be extend up to 25 times of the total height of the trees.

Diversity : Integration of trees itself on the landscape enhances the diversity. However, the trees also in turn increase other organisms which help enhancing the productivity through various means like increased source of food, organic matter and creation of favourable microclimatic conditions. Reports indicate increase micro and

macro fauna of soil, birds and predators and pollinators under agroforestry systems (Honnayya, 2018; Doddabasawa *et al.,* 2018). Such increase in diversity due to existence of trees on the farm helps in enhancing the overall productivity of the farm.

Climate change mitigation : A large proportion of the world's food is grown in tropical rainfed systems where climate variability may play an important role in productivity. Mean seasonal climate has been shown to have great influence on agricultural production across a range of crops, with extreme variations affecting crop development (Slingo *et al*., 2005). This suggests that there are thresholds above which crops become highly vulnerable to climate and weather extremes (Challinor *et al*., 2005).

In the face of increasing climate variability, it will be important to find sustainable and financially viable coping strategies for small farmers who have no access to technological improvements. The presence of trees in agriculture can have beneficial ecological functions on the agroecosystem through the mitigation of microclimate variability (Ewel 1999; Gregory and Ingram 2000). Agroforestry plays a critical role in modifying the microclimate by lowering soil temperature and reducing soil moisture evaporation through the combination of mulching and shading.

The shade trees are extensively used to protect the heat sensitive plantation crops like coffee, cacao, ginger, turmeric and cardamom from high temperature. Lin (2007) reported that the use of agroforestry systems is an economically feasible way to protect crop plants from extremes in microclimate and soil moisture and should be considered a potential adaptive strategy in areas that will suffer from extremes in climate. Similarly Beer *et al*., 1998 summarized that shade trees buffer high and low temperature extremes by as much as 5°C.

Agroforestry is widely considered as a potential way and low cost method to sequester atmospheric carbon and, therefore, recognized as one of the strategies for climate change mitigation (Alavalapati and Nair, 2001). In agroforestry system, tree components are managed and pruned for reducing competition, and these pruned materials are generally non-timber products. Such materials are returned to soil to increase carbon biomass. The effectiveness of agroforestry systems in storing carbon depends on both environmental and socio-economic factors; in humid tropics, agroforestry systems have the potential to sequester over 70 Mg/ha in the top 20 cm of the soil (Nair *et al*., 2009). The carbon storage capacity in agroforestry varies across species and geography (Albrecht and Kandji, 2003). Further, the amount of carbon in any agroforestry system depends on the structure and function of different components within the systems put into practice (Schroeder 1993). Agroforestry systems can have indirect effects on carbon sequestration as it helps decrease pressure on natural forests that are the largest sinks of terrestrial carbon. They also conserve soils and thus enhance carbon storage in trees and soils. Effects of agroforestry practices on the soil carbon pool indicated a rate of increase by 2-3 Mg/C/ha/yr (Montagnini and Nair, 2004). Estimations of carbon sequestration potential in various studies ranged from 6.3GtC and 0.7-1.6 GtC (Indu *et al*., 2013).

Energy analysis : An important challenge facing the world today is the decreasing energy supplies and finite environmental resources. To meet this challenge the sustainability of agricultural methods must be evaluated to determine how yields can be maximized relative to their resource use and environmental degradation. However, Agriculture operates at the interface between nature and the human economy and combines natural resources and possibly purchased inputs to produce food. While the value of economic contributions is routinely quantified by economic analyses, such approaches often underestimate environmental contributions to production systems.

If environmental inputs are not properly accounted for, relative to economic inputs, optimum use of resources may not be achieved, and management decisions will be based on incomplete information (Ulgiati *et al*. 1994). Studies highlight the need for integrated approaches that quantify economic and environmental inputs to select sustainable systems that meet future needs (Odum 1996; Lefroy and Rydberg 2003). While it is widely recognized that assessment of sustainability requires integrating ecological, economic and social factors, decision making is currently based on a fragmented process that lacks a common language. A general definition of sustainable agriculture is "the ability to maintain production over long time frames despite major ecological and socio-economic perturbations and stress" (Conway 1985; Altieri 1987). Economic sustainability is commonly assessed by calculating profitability, cash flow and returns on investment. Resources and resource degradation

are also occasionally valued directly in economic terms although placing a dollar value on ecosystem services and their disruption remains problematic.

Energy (in terms of solar, fossil fuel or electricity *etc.*) analysis, which evaluates system components on a common unit basis is another promising tool to evaluate resource use and productivity of farming systems (Odum 1988, Chittapur and Doddabasawa 2018). For instance, solar energy - defined as the amount of solar energy used up directly and indirectly to make a service or product- is expressed as solar emJoules (sej). Process analysis methodology is commonly used in energy analysis wherein inputs and outputs are traced following physical material flows in a system boundary and which further transformed into energy flows using specific energy equivalents or energy coefficients. The energy of a product or service is calculated by multiplying its available energy by its transformity. Transformity is defined as the ratio of energy required to make a product or service to the available energy of the product or service expressed as solar emJoules/Joule, or solar emJoules/kg (Brown and Ulgiati, 1977).

In southern Germany, Lin *et al.*, 2017 compared organic and conventional farming systems – mixed farming, arable farming and agroforestry systems (Table-3). Conversion from multi-structured organic farming to a specialized organic arable farming reduced fossil energy input in crop production only marginally (from 5.9 Gj/ha), but considerably decreased dry matter yield (from 5.4 to 2.5 Mg/ha/ yr), energy output (from 99 to 46 GJ/ha) and EUE (from 16.8 to 8.3). Improved management in the conventional arable farming system (with high yielding varieties and better N management) reduced energy input from 14.0 to 12.2 GJ/ha, increased the energy output from 155 to 179 GJ/ha/yr and elevated the EUE from 11.1 to 14.6. While, agaroforestry systems with short rotation trees (without fertilization and pesticide use) led to the reduction of energy input greatly. Presently, the energy inputs are highly dependent on non renewable energy such as diesel. The use of renewable energy in agriculture (*e.g.* biodiesel and renewably-produced electricity) is one way to reduce the dependency on fossil fuels and greenhouse gas emission.

Table-3 : Energetic performance and related parameters at Scheyern Research Farm.

Parameter	Unit	Organic arable farming	Organic mixed farming	Conventional arable farming	Conventional mixed farming
Livestock[a]	LU/ha	0	0.9	0	16
N input[b]	Kg/ha/yr	1.39	174	246	275
Energy input	GJ/ha	6.3	7.5	12.1	12.3
Energy output	GJ/ha	76.3	123.5	153.7	167.3
EUE		12.1	17.2	11.8	13.6

[a]Lu = Livestock unit, [b]N input = N deposition + symbiotic N_2 fixation + mineral N + farmyard manure + straw/green manure.

CONCLUSION

The goals of social, economical and ecological sustainability could be realized through agroforestry land use system as compared to other approaches as it encompasses the objectives of the other approaches also. Further, because the system is already being practiced by part of the farmers it is easy to understand and adopt by other farmers also. Therefore, agroforestry could be considered as the best strategy for natural resource management and building resilience to climate change. Even the system energy assessments and by and large ecofriendly nature also strongly favour these systems in place of conventional monocropping or food crop based systems. Hence, we strongly approve agroforestry systems as semi-natural farming systems as alternative to conventional farming to tackle the challenges of food security and environmental sustainability.

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COMMUNITY RADIO : AN IMPORTANT TOOL FOR REACH TO UNREACHED

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In December July 2013, the Government of India approved a new scheme namely "Supporting Community Radio Movement in India" for providing financial assistance to Community Radio Stations under the component Community Radio Support Scheme (CRSS). The matter has been reconsidered and the Government has now decided to revise the guidelines in terms of eligibility criteria including of amount of grant and procedure for release of grant etc. The Community Radio is a type of radio service that caters to the interests of a certain area, broadcasting content that is popular to a local audience but which may often be overlooked by commercial or mass-media broadcasters.

Concept of community radio : Community Radio is confined to a small geographical area. It depends on low power transmission covering not more than 20-30 km. radius. It serves a community which uses common resources for livelihood, has common development issues and concerns, which are relatively localized, nevertheless connected to national and regional development goals.

Community Radio is a vibrant community broadcasting system to enhance pluralism and diversity. It is a truly people's radio that perceives listeners not only as receivers and consumers, but also as active citizens and creative producers of media content. This form of radio is fully consistent with the letter and spirit of the Milan Declaration on Communications media have a responsibility to help sustain the diversity of the World's cultures and languages and that they should be supported through legislative, administrative and financial measures. Community Radio is distinguished by three essential principles. Community Radio is also characteristics by its limited local reach, low power transmission and programming content that reflects the educational developmental and socio-cultural needs of the specific community it serves. For the purpose of community radio, a community is defined as a non-sectarian group of individuals who are traditionally bound and share a common socio-economic and cultural interest.

Community radio and internet : The internet holds potential for development, especially in rural areas with information about health, agriculture or the environment can be downloaded from it. It can be used to connect health workers, agricultural extension workers or ordinary village, with technical experts to discuss some particular problem and it can be use to put communities in contact with each other for online discussions and debates about issues that effects them.

Community radio for agricultural development : Agriculture has always been a highly knowledge-intensive sector requiring continuous information flow. Farmers' quest for authentic, credible and usable information both from established systems and traditional practices is ever increasing in this fluctuating global environment, to operate efficiently and compete economically. The rapid changes happening around with WTO/globalization, uncontrolled urbanization, uncertainty in climate change, discerning consumer segment and continued farm crisis emphasize the importance of timely, appropriate and need based information and knowledge to meet myriad developmental challenges. Effective extension, education and communication services are probably some of the key strategies for sustaining agricultural growth, strengthening food security and combating hunger and malnutrition. However, diverse socio-cultural backgrounds, linguistic barriers, geographical remoteness and differential incentives make the task of information dissemination challenging.

Agricultural extension is the vehicle or system for delivering useful information to farmers and assisting those farmers to develop requisite knowledge, skills and attitudes to make use of this information or technology effectively. In recent times advances in Information and Communication Technologies (ICTs) are revolutionizing agriculture extension by offering various technological options such as television, internet, mobile, telephony etc.

Objectives of CRSS

(i) To strengthen new and existing CR Stations with resources, capacity and technology so that they could provide access and voice to marginalized communities.

(ii) To promote growth of CRS, especially in remote and rural areas including north eastern part of India, so that people living in these areas could have access to a meaningful medium of broadcast

(iii) To promote socio-economic and cultural development of communities as CRS is a powerful medium for social mobilization.

Grant size through CRSS : The maximum grant size for purchase of equipment will be 75% of the total estimated expenditure, subject to a ceiling of Rs. 7.50 lakhs. *For North Eastern States (Assam, Arunachal Pradesh, Manipur, Meghalya, Mizoram, Nagaland, Sikkim &Tirpura*), maximum grant size for purchase of equipment will be to 90% of the total estimated expenditure, subject to a ceiling of Rs. 7.50 Lakhs. The remaining amount will have to be contributed by the grantee.

Eligibility criteria for grant for purchasing equipment by new and existing CRSs

(i) Any organization which has signed Grant of permission Agreement (GOPA) with the Ministry of Information and Broadcasting for setting up of Community Radio Station in India, under the extant Guidelines, amended from time to time, will be eligible for grant.

(ii) It will be mandatory that NGOs/Trusts applying for grant should be registered on the NGO Darpan Portal of NITI Aayog and have obtained unique ID Number.

(iii) Grants will be provided only for equipment listed by the Ministry. The maximum quantity of each equipment to be considered for grant has also been specified. List of equipment shortlisted and specification/ benchmarks thereof are at Annexure.

(iv) No grant will be provided for land/building/electrical wiring or fixtures, furniture, acoustic treatment and software.

(v) The specifications/benchmarks laid down by the Ministry will be only suggestive and not mandatory for installed equipment. Community Radio Stations will be encouraged to follow the indicative benchmarks for equipment being used for setting up of CRS. However, the use of new technology would be facilitated. Ministry would take a six monthly survey, in the months of January & July, of rates of important equipment of different components being offered by producers and set the rates for equipment and maximum rates for any equipment.

(vi) Equipment purchased after date of allocation of frequency/ Decision to Grant License (D/L) by WPC Wing will only be considered for grant.

(vii) A station will be eligible for grant for a particular equipment only once in 6 years. However, an applicant may make applications for different equipments at different times. The maximum grant in one or more attempts will be restricted to Rs.7.5 Lakhs. Stations which have already received grant under the scheme will not be eligible to re-apply for the equipment already supported.

How to apply for Grant for purchasing equipment

(i) No prior approval for release of grant is required from Ministry of Information and Broadcasting. The eligible organizations would be required to apply for release of grant, in the prescribed format, after setting up of CRS and operationalizing it for 3 months.

(ii) Already operational stations may apply for release of grant immediately after purchasing and installation of equipment.

(iii) After receipt of request for grant, two field visits of the operational station will be done by nearest All India Radio/Doordarshan station and by a person deputed by concerned District Magistrate/ local administration. The inspecting officers will submit their reports to the Ministry in the format prescribed by the Ministry with list of equipment/facilities set up and its operationalization status.

(iv) The grant will be released after receipt of both the reports with the approval of Joint Secretary, I & B.

Priority will be given to

(i) Applicants from North-East Region.

(ii) Applicants who have not received any grant in the past, or are not presently receiving Government grants/public funds for the setting up and/or running of the Community Radio Station. If an applicant has access to or has availed public funds for the same purpose (CR), then the applicant automatically gets deprioritised.

(iii) Applicants from backward districts (Refer BRGF List) iv) Applicants from LWE districts Applicants that demonstrate strong community participation

(iv) Applicants that demonstrate strong community ownership

(v) Applicants that strongly represent the voice of marginalized communities.

Grants for content creation : The grants will be provided to operational CRSs under the scheme "Supporting Community Radio Movement in India" for producing and broadcasting fresh programmes on following themes :

1. Developmental 2. Agricultural 3. Health 4. Educational 5. Environmental 6. Social welfare 7. Community development 8. Cultural programmes

Use of CRS

Community radio station (CRS) or community radio (CR) is another type of radio broadcasting service. There are several subtypes of radio broadcasting: commercial, noncommercial educational (NCE) public broadcasting, and non-profit types like community radio, student-run campus radio stations and hospital radio stations.

In India, Community radio station is operated in frequency modulation (FM) mode. Community radio stations serve geographic communities and communities of interest. They broadcast content that is popular and relevant to a local, specific audience but is often overlooked by commercial or mass-media broadcasters.

Objective sought to be achieved by setting up of CRS : Following objectives are sought to be achieved by the Community Radio Service that we wish to start:

1. Meteorological information based on micro-meteorological data that we wish to obtain from the Department of Meteorology.

2. Sociological information regarding Development activities/ Programmes, Projects, schemes of the government, and related themes of public interest.

3. Interactive programmes to involve students, community women, men and people from different walks of life.

4. Health services- access and solutions.

5. Adolescent development activities by designing special programmes for them related to – Life Skills- stories, case studies and the principles in local and interesting manner.

6. Programmes for women's general interests- their economic independence, rights, family up keep and motherhood.

7. Programmes on parenting.

8. Entertainment programmes.

9. Marketing tips and case studies.

Other Point to be covered by the CRS

1. People are in dire need of information about the-

(a) Weather-especially micro weather conditions and predictions;

(b) Agricultural and veterinary practices, agonies, fears, and facts. More interactional this information giving system becomes, better it would be. A Community Radio system would fulfill this requirement;

(c) Self-help in medical science; for different patients and small-time medical aid;

(d) Career and educational guidance to the youth in the rural hinterland of Gangoh Block;

(e) Skill-development projects, where they are being run, participating conditions etc;

(f) Loans-small and entrepreneurial ones;

(g) Rules, guidance, norms and constitutional provisions related to many women-empowerment issues; gender-justice issues and those related to the welfare of young girls and the adolescents.

2. People wish to participate, especially the young people, with whom they perceive as the elite or the celebrities. It is this normative need of the youth that the TV channels exploit even with a heavy phone toll on the calls that the participants make. Here, in the CRS, the local youth in the Block can get plenty of that participative opportunity to hear their name with a new idea, or with a question, and if the question wins some award, that will be an extra incentive.

3. Entertainment through local folk songs, new-wave local pop songs, and film songs is an all-timefavorite with the rural population. CRS can run such programmes aplenty for their entertainment.

4. Aside from these public demands and perceptions, there is another need that the university feels that every university has; that is a programme for the students about safe sex or abstinence as the best method to avoid HIV and AIDS. A programme specially designed for the students of the area about personal hygiene, HIV/AIDS, GYM guidance, Extra Protein intake for body building etc. is required to be given in an impersonal manner.

GEO-GENETIC DIVERSITY : AN ENGINE TO MAKE INDIA A GLOBAL GI LEADER

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Since the adoption of the Agreement on Trade-Related Aspects of Intellectual Property Rights (the TRIPS Agreement) in 1994, which contains a section on geographical indications (GIs), this form of intellectual property (IP) has attracted increasing attention from policymakers and trade negotiators, as well as producers (mostly of agricultural products), lawyers and economists across the world. It is undoubtedly because of the TRIPS Agreement section on GIs that the issue now appeals to more and more nations beyond the rather restricted list of countries that have traditionally pursued active GI policies. Although India has had in its possession a considerable number of products that could qualify as geographical designators, the initiatives to exploit this potential began only recently when the country established a sui generis system of GI protection with the enactment of the Geographical Indications of Goods (Registration and Protection) Act 1999 (GI Act), coupled with the Geographical Indications of Goods (Registration and Protection) Rules 2002 (GI Rules).

Although India has Geographical indications are distinctive signs used to differentiate competing goods. They are collectively owned with a strong inherent origin-base, namely the geographical origin to which they refer. The reference to geographical origin – most regularly for agricultural products – combined with the use of traditional extraction and processing methods, presents an interesting marketing potential in terms of product branding. Success stories from the world of GIs demonstrate that GIs, if well managed, are intangible assets with interesting potential for product differentiation, the creation of added value, as well as spin-off effects in areas related to the primary product for which the GI is known. India, as a member of the World Trade Organization, enacted the Geographical Indications of Goods (Registration and Protection) Act, 1999 has come into force with effect from 15th September 2003. The source of Geographical origin of the biological material used in invention is required to be disclosed in the specification

A geographical indication is a sign used on products that have a specific geographical origin and possess qualities or a reputation that are due to that origin. Most commonly, a GI consists of the name of the place of origin of the good, such as "Jamaica Blue Mountain" or "Darjeeling". But non-geographical names, such as "Vinho Verde", "Cava" or "Argan Oil", or symbols commonly associated with a place, can also constitute a GI. In essence, whether a sign functions as a GI is a matter of national law and consumer perception. Moreover, in order to work as a GI, a sign must identify a product as originating in a given place. In addition, the qualities or reputation of the product should be essentially due to the place of origin. Since the qualities depend on the geographical place of production, there is a link between the product and its original place of production.

Can geographical indications only be used for agricultural products? : Agricultural products typically have qualities that derive from their place of production and are influenced by specific local, geographical factors such as climate and soil. It is therefore not surprising that a majority of GIs throughout the world are applied to agricultural products, foodstuffs, wine and spirit drinks. However, the use of GIs is not limited to agricultural products. A GI may also highlight specific qualities of a product that are due to human factors found in the product's place of origin, such as specific manufacturing skills and traditions. That is the case, for instance, for handicrafts, which are generally handmade using local natural resources and usually embedded in the traditions of local communities.

Why is GI-tag important?

When a product is given GI status, its price increases in international market (because consumers in first world prefer such "exotic" items).

It boosts exports.

It can boost tourism.

The poor farmers/artisans from the given region have to face less competition from fake guys selling bogus products.

Indirectly leads to sustainable Development.

The GIs will not only help the state maintain uniqueness about its products but also plays a vital role in protecting and promoting the state's cultural and biological diversity.

There are three main ways to protect a geographical indication

So-called sui generis systems (i.e. special regimes of protection).

Using collective or certification marks.

Methods focusing on business practices, including administrative product approval schemes.

Registration Procedure of GIs in India Section 11(2) of the GI Act specifies the documentation requirements for applying for a GI in India. Section 32(1) of the GI Rules replicates these provisions and, in addition, stipulates a few more documentation requirements that include, among other things, the following:

A statement as to how the GI serves to designate the goods as originating from the concerned geographical territory in respect of specific quality, reputation or other characteristics that are due exclusively or essentially to the geographical environment, with its inherent natural and human factors; and the production, processing or preparation of which takes place in such geographical location.

The geographical map of the territory concerned.

The particulars regarding the appearance of the GI as to whether it is comprised of the words or figurative elements or both; an affidavit as to how the applicant claims to represent the interest of the association of persons or producers or any organization or authority established by or under any law.

The standards benchmark for the use of the GI or the industry standard as regards the production, exploitation, making or manufacture of the goods having specific quality, reputation or other characteristic of such goods that is essentially attributable to its geographical origin with the detailed description of the human creativity involved, if any, or other characteristics from the definite geographical territory.

The particulars of the mechanism to ensure that the standards, quality, integrity and consistency or other special characteristic in respect of the goods to which the GI relates, which are maintained by the producers, makers or manufacturers of the goods, as the case may be.

The particulars of special human skill involved or the uniqueness of the geographical environment or other inherent characteristics associated with the GI to which the application relates; and the particulars of the inspection structure, if any, to regulate the use of the GI in respect of the goods for which application is made in the definite territory, region or locality mentioned in the application.

Key Challenges Confronting Indian GIs

Foreign Registration : An essential prerequisite for establishing GI status in foreign countries is obtaining legal protection made available by those countries. However, it may turn out to be a daunting task to acquire legal armour in various target countries as per their respective legal frameworks, more so because there exist significant divergences among countries with regard to the modes and the purposes of protection of GIs. Notably, TRIPS (article 1.1) leaves it up to the member countries to determine the appropriate method of implementing the provisions of the Agreement within their own legal framework.

In countries where protection is available via unfair competition and consumer protection acts, GI right holders may have to spend a considerable amount of money trying to fend off abuses in foreign markets. They may have to launch costly legal actions to seek protection of their GI. In such a case, right holders are often required to prove that their GI is not a generic name and that it has acquired distinctiveness. This can be done via consumer surveys, which are expensive and not always conclusive. As for securing protection *via* passing-off actions, it is also a difficult, expensive and largely an uncertain process.

Enforcement Within and Outside India : Once legal rights over a GI are obtained, they have to be defended and enforced. This entails continuous monitoring of the markets to determine whether counterfeit goods are being

passed off. In addition, disputes may crop up with competitors regarding whether their products and/or marketing efforts are infringing on the GI. While the counterfeiting and infringement cases may at times be settled out of the court, they may often end up in legal battles in courts. While the rampant misuse of many Indian GIs demonstrates the urgent need for effective enforcement, the extent of misuse that has already cropped up makes the task rather difficult.

Brand-Building, Promotion and Marketing : When it comes to reaping commercial benefits out of GI status, it needs to be recognized that GIs do not sell themselves. The market potential for this ''niche'' is actually contingent on the consumer recognizing and valuing the product–place link. Hence, the success in exploiting the commercial potential of a GI is, to a great extent, dependent on effective marketing and promotional efforts to develop consumer perceptions about the product, its quality and value. Building up reputation about a GI product is not an easy task, however. It takes enormous time, patience, resources, quality control and a well-crafted marketing strategy, to name a few, to create a valuable GI. ''Champagne'', for instance, is said to have taken as long as 150 years to develop that premium brand image.

Total number of registered GI's in India stands at 361, Karnataka being the top state having registered 39 GI's. Few among them are Nanjangud banana, Ganjifa cards of Mysore, Navalgund durries, Karnataka bronzeware, Udupi mallige, Hadagali mallige, lkal sarees, Molakalmuru sarees, Coorg greegreen cardamom, Dharwad pedha and recently Gulbarga Tur Dal. Maharashtra is ranked second.

Kalburgi Tur/ Gulbarga Tur Dal: The new GI tag G.I. No. 593 GI Certificate issued on 14th August, 2019 : Application was made by (i) University of Agricultural Sciences, Raichur, UAS Campus, Lingasugur Road, Raichu, Karnataka, India (ii) Karnataka Togari Abhivrudhi Mandali Limited, APMC Yard, Nehru Gunj, Kalaburagi, Karnataka, India for Registration in Part A of the Register of Gulbarga Tur Dal under Application No. 593 in respect of Tur Dal falling in Class-31 is hereby advertised as accepted under Sub-section (1) of Section 13 of Geographical Indications of Goods (Registration and Protection) Act, 1999.

Specification : Gulbarga Tur Dal is a local variety of Pigeonpea which is brown in colour and known as Gulyal/Chaple/Bennur local.

Botanical classification :

1. Kingdom : Plantae – Plants
2. Subkingdom : Tracheobionta – Vascular plants
3. Superdivision : Spermatophyta – Seed plants
4. Division : Magnoliophyta – Flowering plants
5. Class : Magnoliopsida – Dicotyledons
6. Subclass : Rosidae
7. Order : Fabales
8. Family : Fabaceae
9. Genus : Cajanus
10. Species : Cajanus cajan (L.) Millsp. – pigeonpea

'Gulbarga Tur Dal' is famous for its unique taste, aroma and shelf life which is due to the richness of calcium (Ca) and potassium (K) in the soils of the region, along with high milling qualities. The milling quality of the dal is high due to the spherical nature of the dal grains which make it a premier quality dal, called "patka dal". This local Tur Dal is quite unique as compared to the other varieties of tur cultivated in various parts of Karnataka in terms of taste, aroma, lesser cooking period and higher shelf life quality.

Description :

(**a) Physical Characteristics**: Plants of 'Gulbarga Tur Dal' grows about 160 to 175 cm with semi spreading branch

habit. Flower colour is yellow, with very sparse red stripes on base petal. Flowering starts at 85 days after sowing and completes by 100 to 105 days. Matures in 145 to 150 days from date of sowing hence, belongs to mid early maturity group. Weight of 100 'Gulbarga Tur Dal' whole grains is 9.5 to 10 grams with round shape and ideal for millers as compared to the other tur grains. 'Gulbarga Tur' is brown in colour and "Dal" is orange yellow in colour, Split Dal is very Attractive, dal edges are very clear

(b) Climate: Gulbarga is situated in north – eastern part of Karnataka. The district normally receives less annual rainfall and faces uncertainty of rainfall. The climatic conditions of this district are relatively warm and dry. Redgram is best suited for cultivation in Gulbarga district. Annual average rainfall varies between 700 to 750 mm. Average annual rainfall of last ten years is noted as 737 mm. The climate of the district is generally dry with temperature ranging from 10ºC in the winter to 45ºC in the summer. Highly fertile black cotton soils derived from lime stone are very much suitable for redgram cultivation.

(c) Significance of Gulbarga Tur Dal : The tur (pigeonpea or arhar) grown here is of superior quality, having to with this region's unique soil and climatic conditions. The soils are very rich in calcium and potassium which is one of the key reasons for unique dal quality and taste of pigeonpea. Quality tur dal from this region largely distributed and marketed to other regions/states of India. Gulbarga alone has some 250 dal mills, with capacities to process i.e. de-husk and split the grain between 10 to 15 tonnes of tur per day

Proof of Origin (Historical records) : 'Gulbarga Tur Dal' is being cultivated since a long period of time in this region. The economy of the empire was largely dependent on agriculture. Sorghum (jowar), cotton, and pulse legumes grew in semi-arid regions. Gulbarga was known as Kalaburagi which means 'stony land' or 'stone roofing' or 'heap of stones' in Kannada. The major stone was 'lime stone' and soils with a large lime content are said to yield the best quality. The quality of the pulse consists in the quickness with which it softens on boiling.

Method of Production : Gulbarga district normally receives less annual rainfall and faces uncertainty of rainfall. The climatic conditions of this district are relatively warm and dry. Pigeonpea being a drought tolerant crop is best suited for cultivation in Gulbarga district during Kharif season. Most of the farmers of this district are cultivating tur as a main crop and is an important cash crop for the farmers in this region.

Gulbarga Tur Dal cultivation method follows stepwise activities as listed below:

(i) By cleaning off all the natural residues, a full-size ploughing is done in the farm generally from third week of May followed by two turns of cultivator.

(ii) In accordance with the rainfall in between 15th June to end of July, sowing is started when tilth is achieved. Previous years preserved seeds are used for this purpose.

(iii) With the help of seed drill and maintaining row to row distance of 90 to 120 cm (for defending the soil fertility), the soil is ploughed and seeds are sown. More spacing is given for fertile soils. Seeds are sown at the rate of 4-5 kg per acre of land.

(iv) Along with available FYM in one's own yard of farmers, one bag of Di Ammonium Phosphate, (DAP) is added per acre at the time sowing.

(v) Hand weeding is carried out at 3 to 4 weeks after sowing, followed by 1 or 2 harrowing in between rows of pigeonpea.

(vi) Two to three sprays with botanicals (Neem seed kernal extract/ Chilli-garlic extract) or bio agents (HaNPV) or pesticides or in combination are used to manage pests, mainly Helicoverpa sp.

(vii) Commonly used commercial pesticides are profenophos @ 2 ml/litre as first spray (ovicide) followed by botanicals or indoxcorb @ 0.3 ml /litre or spinosad @ 0.1ml/ litre or flubendamide @ 0.2 g/litre.

(viii) Sickling is done in the month of August. Some farmers plough the spaces between pigeonpea lines for preventing soil from evaporation or volatilization of moisture. Moreover, soil support is also given to plants with this operation.

(ix) After harvesting, pigeonpea whole plant is dried in the field or threshing yard

(x) Seeds are separated from plants by beating the dried pods with stick followed by winnowing or farmer with large holding go for mechanisation.

(xi) Farmers store tur grains, in their houses packed in gunny bags. They store it for a maximum period of 12 months. No chemicals are used for preservation during storage. Traditionally, famers use dried neem leaves, Ash, sand, chilli powder etc., to avoid insect attacks during the storage period.

(xii) Produce that is locally milled using stone mill (chakki), is used for house hold purposes. The produce is either milled using Stone mills which are operated under low pressure or through Dal mills for splitting of the grains. The final dal produce is available in three forms: split oiled, split dry and whole. Milling quality is high due to the spherical nature of seeds, premier quality dal called "patka dal"

Uniqueness:

(i) Major parameters : Gulbarga Tur Dal is quite unique as compared to the other varieties of tur cultivated in various parts of Karnataka in terms of taste, aroma, lesser cooking period and higher shelf life quality.

(a) **Colour:** Physical appearance of dal is Orange yellow in colour

(b) **Aroma**: Pleasant aroma during and after cooking

(c) **Taste/Flavour**: Highly relishable and highly preferred compared to other dals

(d) **Texture:** Fine texture of cooked sample, physically looks good

(e) **Appearance:** Split Dal is very attractive, dal edges are very clear and edges are not broken

(ii) Sensory Characteristics : The sensory characteristics of Gulbarga Tur Dal in terms of Colour, Aroma, Taste/Flavour, Texture and Appearance is as follows :

Tur Dal test report for Sensory characteristics

S. No.	Parameter	Gulberga Tur dal (Gulyal Local)
1	Appearance	4.40
2	Colour	4.25
3	Flavour	4.0
4	Texture	3.95
5	Taste	4.25

Highly acceptable = 5 Moderately acceptable = 4 Fairly acceptable = 3 Acceptable = 2 Not acceptable = 1 (5-point scale)

Soil Property : The soils of Gulbarga have been compared with soils in Raichur and Bangalore to draw an analysis of the Potassium and Calcium content in each of the soils to understand how the micro-nutrient % influences the quality of Crop yields. The lab reports depict that soils of Gulbarga are very rich in calcium (Ca) i.e. 3.6 g/100 g of soil in comparison with to Raichur soil (0.115 g/100 g) and Bangalore soil (0.135 g/100 g). Hence, the pigeonpea grown here is of best quality, cooks faster and has good taste.

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AN ANALYSIS ON INFLUENCE OF SOCIO-ECONOMIC STATUS AND SELECTED ANTHROPOMETRIC VARIABLES ONTHE ATHLETIC PERFORMANCE OF UAS RAICHUR INTER-COLLEGIATE ATHLETES

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Abstract

In sport, the characteristics of physical, physiological, psychological, sociological and anthropometrical are functionally associated with the performance of a player or an athlete. Considering the requirements of these characteristics in sport, each sport has its own entity since they differed from one another in nature. Meanwhile, though a particular sport has been defined in the requirements of these characteristics, within variance in spot may arise because of variations exist among the players of particular sport in terms of physical, sociological and anthropometric aspects. The main purpose of the study is to compare the selected anthropometric measurements and socio-economic status among UAS, Raichur inter-collegiate athletes. Further to find out the relationship of anthropometric measurements and socio-economic status in relation to their performance among UAS, Raichur campus inter-collegiate athletes respectively. To achieve the purpose of the study total 36 inter-collegiate athletes in the age group of 18 to 25 years studying in UG Colleges affiliated to University of Agricultural Sciences, Raichur, Karnataka, India were selected as subjects by random sampling method.

The results of the study found that there is a significant difference between in calf and thigh circumference, arm length and leg length among UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes. Further, there is a significant influence of socio economic status and anthropometric variables onthe UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletesin the performance of 100 mtrs event.

INTRODUCTION

Sports are an important part of the society and an integral feature of everyday life. Sports and Physical Education play an important role in human development. Games and other outdoor activities, properly planned and executed, promote social harmony, discipline and increased productivity.

In sport, the characteristics of physical, physiological, psychological, sociological and anthropometrical are functionally associated with the performance of a player or an athlete. Considering the requirements of these characteristics in sport, each sport has its own entity since they differed from one another in nature. Meanwhile, though a particular sport has been defined in the requirements of these characteristics, within variance in spot may arise because of variations exist among the players of particular sport in terms of physical, sociological and anthropometric aspects.

Specific anthropometric characteristics are needed to be successful in certain sporting events. It is also important to note that there are some differences in body structure and composition of sports persons involved in individual and team sports. The tasks in some events, such as shot put or high jump, are quite specific and different from each other and so are the successful physiques. This process whereby the physical demands of a sport lead to selection of body types best suited to that sport is known as "morphological optimization" (Bloomfield *et al.*, 1995).

Socio-economic status (SES) and Anthropometric measurements are important determinants of sports performance and various studies shown that lower SES and higher SES have significant effect on the sports performance in the background of socio-economic conditions of athletes and also body anthropometric measurements are the predictors of sports performance and various studies shown that players with same height and weight may not be similar in the efficiency of execution of movement and sustainable capacities since the segments of body part are varied in terms of its length, width, and circumference etc.

Socio-economic factors play a vital role in an individual's performance in sports. The socioeconomic status

make-up of an individual plays an important role in their achievements in every field of life. Socio-economic status also Influence on habitual physical activity (Drenowatz *et. al*. 2010).

Keeping in view of above facts the present study is designed as an investigation on influence of socio-economic status and selected anthropometric variables in relation to athletic performance of inter-collegiate athletes of University of Agricultural Sciences, Raichur, Karnataka, India.

Purpose of the study : The main purpose of the study is to compare the selected anthropometric measurements and socio-economic status among UAS, Raichur inter-collegiate athletes. Further to find out the relationship of anthropometric measurements and socio-economic status in relation to their performance among UAS, Raichur campus inter-collegiate athletes respectively.

Objectives of the study :

To compare the differences in the selected anthropometric measurements amongUAS, Raichur inter-collegiate athletes.

To find out the influence of socio-economic status and anthropometric measurements on the performance of UAS, Raichur inter-collegiate athletes.

To find out the relationship between anthropometric measurements and performance of UAS, Raichur inter-collegiate athletes.

To find out the relationship between socio-economic status and performance of UAS, Raichur inter-collegiate athletes.

MATERIALS AND METHODS

To achieve the purpose of the study total 36 inter-collegiate athletes in the age group of 18 to 25 years studying in UG Colleges affiliated to University of Agricultural Sciences, Raichur, Karnataka, India were selected as subjects by random sampling method.

The socio-economic status and selected anthropometric variables such as body arm length and leg length, calf and thigh circumferences of inter-collegiate athletes were measured. The performance of 100 mtrs running event is taken in the form of time during the UAS Raichur Inter-Collegiate Athletic Meet 2018-19 held at UAS, Raichur campus.

RESULTS AND DISCUSSION

Table-1 : The comparisons (paired t-test) on Calf Circumference between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

Paired Samples Statistics (Calf Circumference)						
Pair	Groups	Mean	N	Std. Deviation	t-value	Sig. (2-tailed)
Pair 1	UASR	34.30	12	3.25	3.63*	.001
	ACB	32.26	12	2.57		
Pair 2	UASR	34.30	12	3.25	2.41*	.019
	ACK	33.26	12	1.77		
Pair 3	ACB	32.26	12	2.57	2.77*	.004
	ACK	33.26	12	1.77		

*Significant at the 0.05 level.

*ACK: Agriculture College, Kalaburagi, *ACB: Agriculture College, Bheemarayanagudi

It can be seen from the table-1 that the value t-statistics (3.63, 2.41 and 2.77) of paired samples test between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes, respectively. The t-values are significant as the p-values (0.001, 0.019 and 0.004) are less than 0.05. Thus, it can be concluded that the

mean values of calf circumference between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes are not similar. In other words there is significant difference in calf circumference between above said UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

Table-2 : The comparisons (paired t-test) on Thigh Circumference between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

Paired Samples Statistics (Thigh Circumference)						
Pair	Groups	Mean	N	Std. Deviation	t-value	Sig. (2-tailed)
Pair 1	UASR	42.86	12	2.18	4.23*	.000
	ACB	38.38	12	1.77		
Pair 2	UASR	42.86	12	2.18	5.84*	.000
	ACK	36.62	12	1.64		
Pair 3	ACB	38.38	12	1.77	2.82*	.012
	ACK	36.62	12	1.64		

*Significant at the 0.05 level.

*ACK: Agriculture College, Kalaburagi, *ACB: Agriculture College, Bheemarayanagudi

It can be seen from the table-2 that the value t-statistics (4.23, 5.84 and 2.82) of paired samples test between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes respectively. The t-valuesare significant as the p-value (0.000, 0.000 and 0.015) are less than 0.05. Thus, it can be concluded that the mean values of thigh circumference between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes is not similar.

In other words there is significant difference in thigh circumference between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes respectively.

Table-3 : The comparisons (paired t-test) on Arm length between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

Paired Samples Statistics (Arm length)						
Pair	Groups	Mean	N	Std. Deviation	t-value	Sig. (2-tailed)
Pair 1	UASR	77.38	12	8.68	3.52*	.000
	ACB	73.96	12	5.36		
Pair 2	UASR	77.38	12	8.68	6.13*	.000
	ACK	71.45	12	4.12		
Pair 3	ACB	73.96	12	5.36	2.63*	.015
	ACK	71.45	12	4.12		

*Significant at the 0.05 level.

*ACK: Agriculture College, Kalaburagi, *ACB: Agriculture College, Bheemarayanagudi

It can be seen from the table-3 that the value t-statistics (3.52, 6.13 and 2.63) of paired samples test between UAS, Raichur, AC, Bheemarayanagudi and AC, Kalaburagi athletes respectively. The t-values are significant as the p-value (0.000, 0.000 and 0.015) are less than 0.05. Thus, it can be concluded that the mean values of thigh circumference between UAS, Raichur, AC, Bheemarayanagudi and Agriculture College, Kalaburagi athletes are not similar. In other words there is significant difference in thigh circumference between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

Table-4 : The comparisons (paired t-test) on Leg length between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes**.**

Paired Samples Statistics (Leg length)						
Pair	Groups	Mean	N	Std. Deviation	t-value	Sig. (2-tailed)
Pair 1	UASR	86.75	12	21.01	2.05*	.045
	ACB	92.61	12	3.79		
Pair 2	UASR	86.75	12	21.01	3.44*	.001
	ACK	96.03	12	6.27		
Pair 3	ACB	86.75	12	21.01	3.16*	.002
	ACK	95.50	12	4.19		

*Significant at the 0.05 level.
*ACK: Agriculture College, Kalaburagi, *ACB: Agriculture College, Bheemarayanagudi

It can be seen from the table-4 that the value t-statistics (2.05, 3.44 and 3.16) of paired samples test between the UAS, Raichur, AC, Bheemarayanagudi and Agriculture College, Kalaburagi athletes respectively. The t-values are significant as the p-values (0.045, 0.001 and 0.002) are less than 0.05. Thus, it can be concluded that the mean value of arm length between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletesare not similar. In other words there is significant difference in arm length between UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

Influence of Socio Economic Status on the performance of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes : To find out the influence of socio economic status on the performance of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes the researcher used the descriptive statistical method like paired t-test with the help of socio economic status scores and 100 mtrs. event performance of athletes and presented in the following ways,

Table-5 : Mean, Std. Deviation and t-values between 100 mtrs performance scores of UAS, Raichur athletes.

Groups	**N**	Mean (in secs)	Std. Deviation	t-value
High SES	18	11.32	0.84	2.63*
Low SES	18	13.63	0.79	

*Significant at the 0.05 level.

Table-5 presents the paired samples Mean, Std. Deviation and t-values between 100 mtrs performance scores of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes. The mean score of high SES group athletes in 100 meters event (11.32) is lower than the mean score of low SES group athletes (13.63) and t-value (2.63) is significant at 0.05 level. In other words it is interpreted that the high SES group athlete'staken less time in 100 meters event performance than the low SES group athletes.

Influence of Anthropometric Variables on the performance of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes : To find out the influence of anthropometric variableson the performance of UAS, Raichur, AC, Bheemarayanagudi and AC, Kalaburagi athletes the researcher used the descriptive statistical method like paired t-test with the help of anthropometric variablesscores and 100 mtrs. event performance of athletes and presented in the following ways.

Table-6 : Mean, Std. Deviation and t-values between 100 mtrs performance scores of UAS, RaichurKalaburagi athletes.

Groups	N	Mean (in secs)	Std. Deviation	t-value
More	18	11.21	0.73	3.12*
Less	18	13.14	0.67	

*Significant at the 0.05 level.

Table-6 presents the paired samples Mean, Std. Deviation and t-values between 100 mtrs performance scores of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes. The mean score of more group athlete's of anthropometric variables in 100 meters event (11.21) is lower than the mean score of less group athlete's of anthropometric variables (13.14) and t-value (3.12) is significant at 0.05 level. In other words it is interpreted that the athlete's group that having more measurement in anthropometric variables are taken less time to cover the distance of 100 meters than the less measurement group athletes.

Relationship between Socio Economic Status, Anthropometric Variables and 100 mtrs performance of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, **Kalaburagi athletes :** To find out the relationship between Socio Economic Status,Anthropometric variables and 100 mtrs performance of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes the researcher used the Pearson correlation co-efficient (r-values) statistical method with the help of Anthropometric variables scores and 100 mtrs performance scores presented in the table 7 following ways,

Table-7 : Correlation co-efficient (r-values) of variables.

S.N.	Variable and Performance	r-values
1.	Socio Economic Status& 100 meters scores	0.71**
2.	Anthropometric variables& 100 meters scores	0.78**

**Significance at 0.01 level

Table-7 : presents r-values between the Socio Economic Status, Anthropometric variables and 100 mtrs performance of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes. It can be observed that the correlation co-efficient (r-values) between Socio Economic Status and 100 mtrs performance scores, Anthropometric variables and 100 mtrs performance scores of athletes are significant at 0.01 level.

Thus the significant r-values clearly indicates that the significant relationship between these independent and dependent variables. It means that the Socio Economic Status andAnthropometric variables have positive significant influence on the performance of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

CONCLUSIONS

There is a significant difference between in Calf and Thigh circumference, Arm length and Leg length among UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

There is a positive influence of Socio economic status on the performance in the 100 mtrs event of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

There is a significant influence of Anthropometric variables on the performance in the 100 mtrs event of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

There is a significant relationship between Socio economic status, Anthropometric variables and performance of UAS, Raichur, Agriculture College, Bheemarayanagudi and Agriculture College, Kalaburagi athletes.

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BREEDING STRATEGIES TO COMBAT ABIOTIC STRESS IN PULSES

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Pulses are an important source of dietary protein especially for millions of vegetarians of India. The group comprises chickpea, pigeonpea, mungbean, urdbean, lentil, fieldpea, rajmash and grasspea besides several other grain legumes of local importance such as cowpea, mothbean, horsegram, fababean, ricebean, and the like. The dry grains of pulses are used mainly as 'dal' as a supplement to cereals, making the food as a perfect mix. However, in India and some parts of the world, immature seeds are also used as vegetables. Besides this, they also add significant amount of nitrogen to the soil by fixing atmospheric nitrogen in their root nodules.

In the developing countries like India, pulses are still crops of typically low input agriculture, which hardly receives better than average management practices. Such environments are prone to large errors, less differentiation between genotypes, and less repeatability across years. The prediction and management of such environments have become even more difficult under changing climatic scenario. Components of such environments largely include abiotic stresses such as extremes of moisture (water logging/drought) and temperature (high/low), salinity and mineral stresses (such as Al toxicity in acid soil). In low-input agriculture and/or low productivity environments in which most variables are unpredictable, high G-E interactions are observed. Consequently, identification of superior genotypes becomes very difficult. Before suggesting breeding strategies, it is pertinent to understand the nature and complexity of abiotic stresses.

The yield level of a crop reflects many facets of crop growth including environmental factors such as rainfall, temperature, sunlight and humidity and cultural factors such as planting date, row spacing, cultivar selection and tillage method. As a result, the interpretation of a relationship is difficult; however response is likely at low yields at high soil test values.

Nature of Abiotic Stresses in Pulses : Abiotic stress is deviation from optimum production condition arising due to non-living components of environment (such as high or low temperature and moisture, high salinity or acidity in soil, etc.) that adversely affect growth and reproduction of crop plants.

Soil degradation and related production constraints : Physical degradation like soil erosion, soil crusting and compaction, chemical degradation like loss of organic matter, soil fertility, multi nutrient depletion and deficiencies, salt accumulation, pollution, etc., are some of the major soil and management-related problems reported which account for nearly 60% (188 M.ha) of the total land area . Soil acidification is a natural soil-forming process accelerated by high rainfall, low evaporation, leaching of bases, and high oxidative biological activity that produces acid. The soil acidity plays major role in determining the nutrient availability to plants and in many instances by specific mineral stress problems. Production constraints are more intense on acid soils, which cover 30% of the world's land area. Acid soil infertility is a syndrome of problems that affect plant growth in soils with low pH. This complex of problems arises from toxicities and deficiencies in acid soils are related to :

Presence of the toxic concentration of Al and to a lesser extent Mn toxicity in many species,

Deficiency of bases (Ca, Mg, K) and their poor retention power,

High P fixation capacity of soil caused by highly active Al and Fe surfaces, rendering it unavailable to plants,

Deficiency of Mo, especially for the growth of legumes,

Reduction of soil biological activities,

Impairment of N_2-fixation by legumes caused by poor survival of microsymbiont and inhibition of nodulation, and

Fe and Mn toxicities.

Nutrient mining status : The soil fertility status of Indian soils has declined drastically over the years following the era of green revolution and is marked by a negative balance of 8-10 M. tons between nutrients removed by the crops and those added through manures and fertilizers leading to mining of soil nutrient capital and steady reduction in soil nutrient supplying capacity. The situation is further aggravated by the depletion of major soil

nutrients like N and K in intensive cropping systems and emergence of wide spread deficiencies of secondary (S, Ca) and micronutrients (Zn, Fe, Mn, Cu and B). Soil test data available for major part of the country for the major nutrients (N, P, K) show that 89 and 80% of the soils are low to medium in N and P, and about 50% of the soils are responsive to K supply. District wise soil fertility status of Indian soils also indicates a similar trend.

The potential for developing new crop varieties by means of higher stress tolerance is promising, given recent advances in molecular biology and genomics, with implications of both conventional and transgenic breeding. A better scientific consideration is required of the yield restrictive practices to target future genetic and agronomic improvements and to evade the unnecessary use of inputs during those parts of the crop lifecycle that is not critical for crop growth and yield formation and are more affected by changing climate threats and can vary with countries and agro-climatic regions. Though, the long-term success in breeding crops adapted to climate change may be controlled by a potential loss of genetic diversity caused by temperature rise and shifts in precipitation that lead to range reduction or extinction of crop wild relatives. To counter this threat, maintenance is desired for policies that initiate defining the scope of the climate change risk to crop wild relatives, policies that engage local communities in their conservation, and the formulation of priority-determining mechanisms.

Farmers will need a diverse selection of improved crop varieties that are better adapted locally to ecologically based production practices and suited to resilient to climate change. The introduction of adapted and recognized crop varieties can potentially empower cropping systems by aggregate crop yields with building crop resilience to biotic and abiotic stresses in a sustainable way likewise by means of taking new market opportunities besides increasing crop productivity, quality, health and nutritional value which will help to make sure continuous improved agricultural production even at uncertainties about future climate change impacts and help to create eco-friendly sustainable environment. There are many crop varieties better adapt better to changing climatic parameters.

The topic of nutrient use efficiency has recently gained more attention with rising fertilizer costs and continued concern over environmental impairment. Nutrient or fertilizer use efficiency can be viewed from different perspectives based on yield, recovery or removal. Among the most common expressions of efficiency is the recovery efficiency (RE) of fertilizer nutrient, defined as the percentage of fertilizer recovered in aboveground plant biomass during the growing season. Fertilizer utilization rate (crop recovery efficiency) under favourable conditions for N is about 50-70%, 10-25% for P (15% average), and 50-60% for K. It was also suggested that efficiency of P and K over time (multiple growing seasons) could also be taken into account for realistic estimate. Nutrients that build-up in soil such as P and K, can certainly be viewed over the long term, while N efficiency is viewed on the short term because of its transient nature. Where there is potential for building soil C reserves, long term N efficiency is appropriate because soil C balance also affects N balance'

Reasons for low NUE :

Nutrient losses – Erosion, leaching, runoff, volatilization, denitrification etc.

Soil fixation of nutrients – P in deficient, highly weathered acid soils (Ultisols and Oxisols), K in highly illitic clay soils and Zn in high clay and calcareous soils.

Nutrient interactions - antagonistic interactions between P and Zn, Na and K, Mg and K, Ca and K, Ca and Fe etc.

Imbalanced fertilizer use - imbalanced use of a few straight fertilizers results in reduced availability of other nutrients there by reducing their use efficiency.

Soil related problems - acidity, salinity; alkalinity, calcareous, acid sulphate soils, poor drainage, texture etc. result in poor availability of nutrient elements.

Non – nutrient factors such as lodging, untimely planting, and pest / disease problems limit NUE.

Breeding for abiotic stress is considered more difficult because of: (a) complexity of conditions causing abiotic stresses, (b) complex nature of abiotic resistance in a variety, (c) occurrence of one stress more often in conjunction with the other, (d) low heritability of abiotic resistance, and (e) variable intensity of such stress under field condition. The actual mechanisms employed by individual crop plants vary greatly, and are not homogeneous.

The tolerance to abiotic stress is often conditioned by quantitative trait loci with complex interactions. Besides these, high G×E interactions and lack of precise screening techniques make the task of breeder even more challenging.

Pulses encounter a number of abiotic stresses during various stages and phases of their life cycle. The nature of abiotic stresses may vary depending upon species, prevailing weather conditions and the type of soil. For example, winter grain legumes (cool season pulses) such as chickpea, lentil, peas and fababeans, which relatively tolerate low temperature, more often experiences terminal heat stress during their reproductive period. In low input agriculture, this condition is often intertwined with moisture stress. Warm (rainy) season pulses (e.g., pigeonpea, mungbean, urdbean, etc.,) often experience temporary waterlogging that may vary from hours to a few days. Although urdbean tolerates excess moisture to a greater extent, yield level is adversely affected in case excess water is not drained out after 2-3 days. This group of pulses also encounter moisture deficit owing to uneven rainfall pattern. Besides these, this group is relatively sensitive to low temperature stress. Pigeonpea, which is perennial by nature but is cultivated as a rainy season annual, encounter almost all such stresses such as waterlogging (during seedling stage) and drought and low temperature stresses(during reproductive stage). Depending upon the edaphic conditions, pulses may also face stresses imposed by salinity/alkalinity (high pH), Al toxicity and sodicity. Response of each grain legume to each stress may vary; the expression of stress (strain) may be manifested through effects on different traits. Consequently, different screening techniques and a different kind of breeding strategy is needed to mitigate abiotic stresses.

Screening Techniques and Marker Traits : Genetic variations have been noticed for almost all the abiotic stresses wherever a large number of genotypes have been screened. Marker traits conditioning tolerance to such stresses have also been identified. In the following section, we will discuss the specific screening techniques and the marker traits apt to differentiate genotypes for such a stress as:

Drought : The kind of drought that is of our interest is the *agricultural drought* that occurs where soil moisture and rainfall are inadequate during the growing season to support healthy crop growth to maturity and cause extreme crop stress and wilting of plants. A plant can resist drought condition through reduced water loss from aerial portions, increased water uptake from deep layers of the soil or by giving more yields at low water potentials. The maintenance of water uptake under drought condition is related to several properties concerning roots of plants such as root size and efficiency, root density, size of xylem vessel, and the like. Genotypic differences have been noted for all these attributes in almost all grain legumes. Several screening techniques including soil-based and field screening have been suggested to identify drought tolerant genotypes in grain legumes. Except field screening, these are almost exclusively based on identifying genotypes having long, dense and efficient root systems. Soil based screening techniques have been criticized as several constraints are encountered. To overcome these constraints, one novel screening technique "a new phenotyping technique to screen for drought tolerance in lentil", which is based on hydroponic system, has been recently suggested by. The new screening technique is based on seedling survivability, drought tolerance score, root and shoot length, and fresh and dry weight of roots and shoots. Three genotypes namely, ILL-10700, ILL-10823 and FLIP-96-51 showed the maximum seedling survivability and minimum reduction in the growth parameters with a drought score of 0.0–0.2, indicating higher tolerance to drought stress than other genotypes. The same technique with minor modifications has also been suggested to screen mungbean genotypes for drought tolerance. However, it appears that this technique is based on only partial component of even drought avoidance. Researchers have not corroborated the results of the hydroponic technique with the field level screening. Furthermore, it is also not clear whether the parameters (taken as the index of drought tolerance) confer only survival advantage to the surviving genotypes. Under field conditions, several variables interact to produce final outcome. Therefore, controlled field screening aided by rain-out shelter appears to be more reliable than simply soil or solution culture based screening techniques.

A number of morphological markers such as plant type (spreading or semi-spreading), morphology (leaf area index) and orientation of leaves (leaf angle), cuticular waxiness (which results in 2-50% reduction in transpiration), and leaf reflectance (up to 50% reduction in light absorption) are known to reduce water loss from aerial portion in grain legumes. Some physiological parameters such as water retention capacity of leaves (relative water content), osmotic adjustment, dehydration tolerance and stomatal regulation appear to be equally

important in most of the legumes for combating moisture deficit condition. However, conclusive evidences that these parameters also confer reproductive advantages to the surviving genotypes are scanty. Agronomic traits such as pods/plant, seeds/pod, seed size and seed yield/plant under actual water deficit condition should be given much importance while breeding for drought resistance.

Waterlogging : Water logging refers to soil saturation with water. Some crop plants including rice tolerate this stress by virtue of their special character (presence of aerenchymatous cells). However, other crop plants are prone to waterlogging stress especially at seedling stage. Under waterlogged condition, oxygen diffusion rates in flooded soil is about 100 times lower than air, and respiration of plant roots, soil micro-flora and fauna leads to rapid exhaustion of soil oxygen, eventually causing anaerobiosis. However, proximate causes of plant injury can be oxygen deficit or mineral nutrient imbalances, a decrease in cytokinins or other hormones released from the roots, a decrease in available soil nitrogen and/or nitrogen uptake, an increase in toxic compounds in soil such as methane, ethylene, ferrous ions or manganese, an increase in toxic compounds (in the plant) such as ethanol or ethylene, and an increase in disease causing organisms.

Winter season grain legumes are sensitive to excess moisture compared to rainy season pulses. However, grasspea (*Lathyrus sativus*), a winter season annual that is often grown as a *paira* crop with rice in eastern India, is perhaps the most tolerant to waterlogging. This species needs to be fully investigated for the special attributes that confer upon it this peculiar adaptive advantage. Rainy season pulses such as pigeonpea, mungbean, urdbean, cowpea, and the like, more often encounter this stress owing to uneven pattern of monsoon rainfall. Urdbean, although relatively tolerant to excess soil moisture, may be damaged if there is prolonged waterlogging.

Screening techniques to discriminate tolerant and sensitive genotypes for waterlogging stress has been developed in pigeonpea. A set of test genotypes in 2-3 replications are grown in pots. These pots with two-three weeks' old seedlings are placed in a well-leveled tank and exposed to water treatments (partial submergence) for 6-8 days. After a fixed period of exposure to such stress, water is drained out completely. Data on plant density, chlorophyll content, oxygen content of water, pH of soil and other parameters are taken before and after water treatment. Agronomic data such as days to flowering, plant height, pods/plant, seeds/pod, yield/plant, maturity period, etc. are recorded on surviving genotypes in both treated and control treatments. This screening technique may be satisfactory. However, the timing of the experiment must be such that it mimics that of natural condition.

It has been observed that waterlogging can affect pigeonpea during germination, early and late seedling stages as these stages cover peak monsoon period. These three critical stages can be used for screening of tolerant genotypes. Waterlogging, in general, causes rapid senescence and drooping of the shoot tips of plants. In pigeonpea, it reduces plant height and delays flowering in surviving plants, resulting in the reduction in the number of pods, seeds/pod and seed yield. It has been observed that seed coat thickness, aerenchymatous cells, lenticels and adventitious roots also affect tolerance to waterlogging in pigeonpea. However, these traits need to be confirmed and re-validated before these can be used as selection criteria in crop plants.

The adoption of water saving technologies in general and breeding for aerobic and salt tolerant legumes in particular at the farm level will contribute to increasing water productivity, safe guarding food security, make use of salt affected land areas and alleviating poverty. Assuming an average farm size of 1 hectare, some 17 million farmers who face physical water scarcity and 22 million farmers who face economic water scarcity in 2025 will benefit from water saving technologies. A long chain of introduction, selection and recombination processes led to the development of improved salt tolerant materials which directly benefited the farmers by increasing their harvest in salt affected lands.

Extremes of temperature : In general, warm season grain legumes are relatively tolerant to heat stress and sensitive to low temperature. Winter season pulses, on the other hand, tolerate low temperature, but are sensitive to heat stress (>35°C). Amongst rainy season pulses, traditional pigeonpea encounters low temperature stress during winter months in North India. The stress adversely affects growth, survival and reproductive capacity of plants if the minimum temperature falls below 5°C. Genotypic variations for cold tolerance are well documented in pigeonpea especially for survival traits. Low temperature primarily affects development and growth and opening of flower buds. In some sensitive genotypes (IPA 209 and IPA 06-1), filaments of stamens fail to enlarge at

low temperature and thus affect opening of flowers. Pollen dehiscence does not occur too, although pollens are fully fertile. As a consequence, unfertilized flowers wither and fall down, resulting in no pod formation in these genotypes under low temperature. It appears that formation of floral buds, no. of blossomed flowers and pod setting at low temperature can be used as selection criterion to identify tolerant genotypes in pigeonpea. These traits need to be investigated also in the wild relatives of pigeonpea to screen tolerant wild accessions as have been done in wild relatives.

Winter season pulses (chickpea, fieldpea and lentil) experience terminal heat stress especially during pod formation and grain-filling stages in North India. Screening techniques to identify heat tolerant chickpea genotypes have been developed. Genotypes are grown under late sown condition so that pod formation and grain filling stages (critical stages) coincide natural heat stress. The thermo-tolerance of the selected genotypes involved assessment of their pollen viability at 43°C, nondestructive assessment of photosynthetic ability through fluorescence imaging system and membrane injury test. Pollens of heat tolerant genotype 'ICCV 92944' were deeply stained at >40°C, while the sensitive genotypes 'ICC 14077' and 'PBG 5' showed non-viable pollen without taking stain. The increase in the non-viable pollen decreased fertility in these genotypes substantially at >40°C. Similar observations have been recorded for field pea and lentil. The biomass of lentil decreased significantly in all genotypes under late (January) sown condition compared to under normal (November) plantings. Therefore, lentil genotypes having relatively high biomass under heat stress would be desirable as there appears to be strong association of biomass and seed yield in lentil.

Salinity/alkalinity stress : Soil salinity is an ever increasing problem constraining production of both cool season and tropical and sub-tropical grain legumes in many parts of the world. Salinity of only 3 dS/m in field soils was the threshold for reduced shoot growth and yield in chickpea, although this exceeds the even lower salinity threshold (<1.3 dS/m) in some grain legumes like cowpea, soybean and pigeonpea. In chickpea, germination is less sensitive to salinity than early vegetative stage, and reproductive phase is considered to be even more sensitive than vegetative phase. However the chickpea is sensitive to salinity at both vegetative and reproductive phase, with pod formation being particularly sensitive. The sensitivity occurs even for a reputably tolerant cultivar 'JG 11' even at 20 and 40 mM NaCl levels that is considered relatively mild for many crops including modern wheat with which chickpea may be grown in rotation. In chickpea, 40 mM NaCl may be considered an optimum level to discriminate tolerant and sensitive genotypes. Upon removal of salinity (NaCl), which may hardly be a case under field condition, chickpea shows excellent recovery with substantial new shoot growth. This could happen presumably in almost all pulses as these are endowed with the unique adaptive advantage of having indeterminate growth habit.

Tissue ion regulation is a key trait for salt tolerance in plants, but whether Na or Cl 'exclusion' contributes to tolerance in chickpea remains uncertain. However the sensitivity during the reproductive phase was not caused by changes in pollen viability but was potentially due to toxic accumulation of Na and Cl in flowers, and possibly the sensitivity of pollen tube growth if NaCl entered the stigma. It therefore appears that in chickpea a combination of mechanisms, ion exclusion and tissue tolerance of excess ions are likely to contribute salt tolerance.

Under saline condition, symptoms of leaf necrosis, presumably related to the destruction of chlorophyll in leaf cells resulting from ion toxicity when Na^+ and/or Cl^- exceed threshold level in tissues have been observed; 'visual scores' of necrosis could be used as an index of salinity tolerance in chickpea. Salinity also causes physiological drought so that chickpea is unable to remove as much water from saline soil as from non-saline soil. Although chickpea shows osmotic adjustment, its role in salt-sensitive compared to salt resistant genotypes is not conclusive, and requires further study. Salinity has been shown to decrease number of pods/plant, seeds/pod and size of seeds; nevertheless, size is relatively less affected. No significant difference in seed size of salt-sensitive and salt resistant genotypes, indicating the possibility to develop salt resistant cultivars in the market-preferred seed size category. No consistency in performance was noticed when genotypes selected in seedling stage were brought to maturity under saline condition. It indicates that selections for salt resistance are required across the entire life cycle. Further, as genotypes differ in expression of resistance at different stages, it also provides an opportunity to combine sources of resistance for different stages from contrasting parents in chickpea.

In warm season pulses like pigeonpea, differential tolerance to salinity *vis-à-vis* pigeonpea maturity groups, like chickpea, no correlation was found between the tolerance at germination and later stages. However, percentage survival showed some association with seed yield under salinity. Low and high accumulation of Na and K, respectively in the roots and other plant parts (main stem, branches and leaves) perhaps helped salinity tolerance in pigeonpea. Wild relatives of pigeonpea including *C. scarabaeoides, C. albicans* and *C. platycarpus* have shown a wide range of variation in their salinity tolerance. Certain physiological attributes that confer salinity tolerance in these wild species include Na and Cl retention in the roots and limited translocation to the shoots, high K selectivity and maintenance of transpiration rate under saline conditions. NaCl treatment of 1.01 g/kg alfisol was suitable to salinity screening in pigeonpea, and large variations in the salinity susceptibility index and the percent relative reduction in both cultivated and wild accessions. The amount of Na accumulation in shoot showed that more tolerant genotypes accumulated less Na in the shoot except the wild species, which followed a different pattern compared to cultivated varieties. Overall, they found that *C. acutifolius, C. cajanifolius* and *C. lineata* were mostly sensitive, whereas *C. platycarpus, C. scarabaeoides* and *C. sericeus* provided good sources of tolerance. It was interesting to notice that *C. scarabaeoides* also provided a large range of sensitive materials.

In summary, grain legumes are sensitive to salinity stress. However, genotypic differences for salinity provide opportunity for selecting tolerant genotypes. The level of salt concentration to discriminate sensitive and tolerant genotypes may vary depending upon the species. There is no association of salinity tolerance between growth stages; therefore, screening needs to be performed from vegetative to reproductive stages. Salinity tends to interfere nutrient uptake (Ca, Fe, Mn and Mg), and usually favours accumulation of free proline in plant parts including pods. Ion exclusion (from root), tissue tolerance of toxic ions, and perhaps internal detoxification may be simultaneously operating to mitigate the effects of salinity stress.

Aluminum toxicity : Aluminum toxicity is a well known problem limiting crop production in 30% of arable lands. Considerable variation for tolerance to Al toxicity in plant species and genotypes within species has been reported. Both cool and warm season pulses are sensitive to Al toxicity. The work on screening for tolerance to Al toxicity in these grain legumes are only a few and limited to seedling screening.

However, due to operative simplicity, reliable and better precision and short test period, the hematoxylin staining at 30 ìg/ml Al concentrations was suggested as the best method to discriminate pigeonpea genotypes for Al tolerance. The same Al concentration (30 ìg/ml) has also been suggested for screening of other grain legumes including chickpea. However, the optimum level of concentration may vary in other legumes like lentil, mungbean, etc.

The better performance of tolerant genotypes could be ascribed to better regulation of ionic uptake and their distribution within the plants under different Al concentrations. The Al exclusion from root could be the possible mechanism for Al tolerance. However, internal detoxification in several other crops has also been reported as the possible mechanism of Al tolerance. Still in other cases, tissue tolerance to Al toxicity may also be possible.

Genetics of Marker Traits and Breeding Strategies : Escape mechanism has been invariably and widely utilized to mitigate the effects of abiotic stresses in almost all pulses. However, the same strategy cannot be applied for mineral stresses. It has been evident that during dry and wet years, specific gametic types are favoured separately. By extrapolation, grain legumes are likely to accumulate a specific combination of genes (alleles) if exposed separately to above-mentioned stresses. Therefore, a genotype showing tolerance to drought may react differently if exposed to water-logging and vice-versa. For example, JG-11–a leading chickpea variety of central and south zones in India, which is considered relatively tolerant to heat stress, is not a good performer in north India where atmospheric temperature is comparatively low during winter months (December-January). The best breeding strategy appears to be selection of superior genotypes of grain legumes under actual field condition. We are ultimately concerned with the yield (a measure of relative reproductive capacity) of genotypes. Therefore, selection should be based on yield and sometimes on its component traits. It is often argued that there may be temporal and spatial variation under field condition; therefore, screening should be done under controlled condition. However, under field conditions a number of variables interact to produce final outcome, thus field testing of genotypes cannot be ignored. Therefore, we suggest assessing genotypes for such abiotic stresses under

actual field condition, and the results may be reconfirmed under controlled condition and vice versa. However, selection must finally be practiced for high yielding genotypes.

There are instances where traits in question are mono or oligogenic having high heritability (high regression of offspring on the parents). For example, Al tolerance has been shown to be dominant monogenic in chickpea and oligogenic in pigeonpea. Similarly, pollen dehiscence and pod setting under low temperature and waterlogging tolerance in pigeonpea, salinity tolerance in certain accessions of *Cajanus albicans*, a wild relative of pigeonpea, and winter hardiness in lentil (Frt gene) have also been reported as the dominant monogenic traits. Under such a situation, simple back cross breeding can be used to improve Al or other stress tolerance in pigeonpea or any other concerned grain legume. There are instances when even monogenic/oligogenic traits show high G×E interaction and low heritability. Such a situation calls for improving tolerance through marker assisted backcrossing, which generally involves transfer of a limited number of trait loci including transgenes from one genetic background (donor genotype) to the other genetic background (elite variety) using molecular markers.

However, resistance/tolerance to most abiotic stresses is quantitative in nature. For example, earliness, plant height, plant structure, growth habit and yield in lentil and root traits, drought tolerance score, canopy temperature differential and seed size in chickpea are controlled by several QTLs. The same holds true for yield and its component traits (seed number, seed weight), which should be given due importance while making final assessment of tolerance to such stresses. In such cases, retaining desirable gene combinations or pyramiding of several QTLs through marker-assisted backcross approach may be a challenging task. The best approach is to resort to marker-assisted recurrent selection. In some cases, superior alleles for a given trait (e.g., salinity tolerance in *C. albicans*) are identified and transferred from the wild species to a leading variety/cultivar. Under such situations, advanced backcross QTL approach for simultaneous discovery and transfer of superior alleles from wild species to develop improved lines may be followed as this approach facilitates efficient tracking for desired and non-desired alleles in breeding lines.

INDIAN SEED LEGISLATION, ITS IMPACT ON SEED INDUSTRY AND IN DOUBLING THE FARMER'S INCOME—AN OVERVIEW

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Since legislation is above all an expression of government policy, special legislation pertaining to seed is influenced by agricultural policy as a whole. This is compounded of economic aims and social aspirations, and the balance between them is reflected in the seed laws, which are designed to promote better cash returns per hectare and to protect the farmer against the risk of sowing seed of poor quality or of being otherwise exploited. The seed laws with which we are concerned therefore impose certain restrictions on at least some of the various stages through which seed passes up to the point of sale to the farmer (production, processing, testing, packing, and trading). These restrictions are enforced by penal sanctions.

Seed legislations by Government of India

Seeds Act 1966 : The major legislative measures involved under the Act are Seeds rules framed in 1968, Seeds (Control) order, formulated in 1983 after including seeds as an essential commodity A total of twenty five clauses have been mentioned in the act.

Seed Rules 1968 : The rules have been framed to implement various legislations given under Seed Act, 1966 and contain 11section.

Amendments to the Seed Act/Seed Rules The Seeds (amendment) Rules 1972 : Legislations for Seed Quality Regulation in India Inclusion of "jute seeds" to the Seeds Act, Establishment of a Seed Certification Board, and empowerment of the Board to fix minimum standards.

The Seeds (amendment) Rules, 1973

Powers of appellate authority and duty of seed analyst have been slightly modified. Seed Testing Manual published by ICAR has been mentioned to be referred by the seed analysts.

The Seeds (amendment) Rules 1974 : More powers conferred on seed inspector during crop failure.

The Seeds (amendment) Rules 1981 : A new rule added under the seed certification and has mentioned Indian Minimum Seed Certification Standards published by the Central Seed Committee to be referred for certification.

Seeds (Control) Order 1983 : The inclusion of seeds as an essential commodity item under the Essential Commodity Act, 1955 brought the Seeds (Control) Order.

New Policy on Seed Development 1988 : The policy was formulated to provide Indian farmers with access to the best available seeds and planting materials of domestic as well as imported.

Plants, Fruits and Seeds Order (Regulation of Import into India order) 1989 : The order was made suppressing the Plants, Fruits and Seeds Order (Regulation of Import into India) 1984 and provides regulations during import based on post entry quarantine checks.

Amendments have been made for the above order during 1998, 2000 and 2001. With the liberalized trade in agriculture, as consequence to WTO agreements, Government thought of providing new legislative provisions under the new order, Plant Quarantine (Regulation of import into India) Order, 2003. The Order has now replaced the Plants, Fruits and Seeds order, 1989.

Protection of Plant Varieties and Farmers Right Act 2001 : The Act covers all categories of plants except microorganisms. The variety being claimed for protection needs to be notified The food crops including major cereals, pulses, oilseeds, vegetables and fruit crops are selected on first priority Crops important for India in the world trade, species of Indian origin, crops where India could benefit from introduction of new germplasm are other priorities The act is unique in the world with inclusion of rights of farmers, breeders, researchers and equity concerns The Central Government shall establish a PPV & FR Authority with a Chairman and 15 members to

implement the various functions of the Act A variety can be registered for protection if it satisfies the criteria of Novelty, Distinctness, Uniformity and Stability (NDUS).

Protection of Plant Varieties Rules 2003 : The rules have been enforced for the smooth implementation of the Act, 2001. The rules provide detailed procedures while applying for protection, ways of administering the national gene fund, procedure on application for compensation, procedure to alter the denomination of a registered variety, procedure for cancellation of certificate and all other procedures to be implemented as per the provisions given in the PPV & FR Act, 2001.

India In 2004, India introduced the Seeds Bill to replace the Indian Seeds Act 1966. Farmers' organizations and NGOs have campaigned against it and until now, it has not been enacted, though it remains in Parliament (DDS, personal communication). Its objective is to regulate the quality of seeds for sale, import and export, encompassing all players from seed producers to retailers, and to increase private sector participation in the production, certification, distribution and testing of seeds. According to Ranjan (2009), the Seeds Bill could undermine the PPVFR Act, which incorporates farmers' rights over their varieties. It proposes mandatory registration of all marketed and distributed seeds, which may include seeds of farmers' varieties. Clause 13 Bill states that "no seed of any kind or variety shall, for the purpose of sowing or planting by any group, be sold unless such seed is registered", which appears to apply even to seeds of farmers' varieties held by farmers. The Bill does not set out criteria for registration. In addition, Clause 22 reads: "any person who desires to carry on the business of selling, keeping for sale, offering to sell, bartering, import or export or otherwise supply any seed by himself or by any other person on his behalf shall obtain a registration certificate as a dealer in seeds from the state government". This definition would not exclude farmer-sellers. The two clauses together would impose a double obstacle for farmers to sell their seeds, because they would have to register their seed lots and themselves. However, Article 43 of the Bill states that nothing in the Act shall restrict the rights of the farmer to save, use, exchange, share or sell his/her farm-saved seeds or planting material. The same article does also require that seeds conform to a minimum level of germination, physical purity and genetic purity, which would be difficult to measure and control for small-scale farmers.

National Seed Policy 2002 : National Seed Policy was formulated in 2002 to raise Indias' share in the global seed trade by facilitating advanced scientific aspects such as biotechnology to farmers and in March 2002, first transgenic Bt cotton was approved for commercial cultivation in India.

Seed Bill 2004 : The Seed Bill is proposed to replace the Seed Act, 1966 Compulsory registration of seeds that are to be offered for sale through test for Value for Cultivation and Use (VCU), Seed certification will continue to be voluntary, VCU will be tested by multi- locational trials over three seasons. Samples of materials for registration will also be sent to NBPGR for retention in the National Gene Bank, Enable provisional registration based on the information filed by the applicant relating to trials over one season to tide over the stipulation of testing over three seasons before the grant of registration. The provisional registration will be for a period not exceeding two years. Accreditation of any organization or individual or any seed producing organization to carry out self- certification subject to the control of the seed committee and State Government.

A National Seed Research Training Centre was established at Varanasi during October, 2005. The main mission of the centre is to provide training in modem seed technology aspects such as transgenic testing etc. A seed specific portal has been developed by Seed division with the help of agricultural informatics division, Department of Information Technology to provide information about the requirement, production and availability of quality seeds at different State Agricultural Universities and breeder seed producers through seed net.

Seed Legislation impact on seed industry and in doubling the farmer's income : Seed industry was promoted and regulated through Seeds Act, 1966, Seeds (Control) Order, 1983 and the New policy on seed development, 1988. However, far reaching changes have been taken place in the national economic and agricultural scenario and in the international environment since the enactment of the existing seed legislation.

Bt technology has come up with promises of extremely productive GM crops. It was believed that the new technology has the potential to improve living standards. Various organizations such as ICAR, Ministry of

Environment and Forests, Government of India, Federation of Indian Industries (FICCI) support commercialization of such crops.

National seeds policy was thus formulated in the year, 2002 to provide an appropriate climate for the seed industry to utilize available and prospective opportunities, safeguarding the interest of farmers and conservation of the biodiversity.

Liberalization has been targeted towards certain components of the policy retaining regulation to some components to safeguard national interest.

The policy encourages private sector participation in research and development of new plant varieties.

The rights empowered to various bodies for regulating the quality of seeds produced, distributed and for providing variety protection as per the Seeds Act, 1966 and PPV & FR Act, 2001 have been retained in the policy Promotion of seed village scheme to increase the production and make available the seeds in time as well as upgrading the quality of farmers' saved seeds Establishment of seed banks for ensuring supply in times of calamity and storage facility at village level Establishment of a National Seed Board in place of Central Seed Committee and Central Seed Certification Board to undertake seed certification and advising Government on all matters related to seed planning and development. NSB will serve as the apex body in the seed sector setting up of National Seed Research and Training Centre to impart training in seed technology, Development of a National Seed Grid to provide information on availability of different varieties of seeds with production details. Both public and private sector will be encouraged to join the grid for a clear assessment of demand and supply of seeds Few of Policy's other recommendations have been addressed in PPV &FR, Act, 2001 also. Major ones are maintenance of a National Register on seeds of varieties, establishing a national gene fund, disclosure of the variety's expected performance and provision for farmer to claim compensation in case of crop failure. Further, aims of National Seed Policy such as development of infrastructure, ensuring supply of good quality seeds and facilitating the International seed trade are sought to be addressed through the proposed Seeds Bill, 2004.

Until unless the purity, quality and seed standards are maintained, production programme cannot be successful. To maintain these quality standards, legislations are equally important. Therefore Government of India had taken steps in framing Seed Act, Seed Rules, Seed (control) order, National Seed Policy, Plant quarantine order, PPV & FR Act to not only to protect breeders, researchers but also a common farmer. These legislations have taken care of the quality of the seeds at production, processing, marketing and labeling and marketing levels to ensure the farmer gets the best quality seed. Therefore it is necessary that the information regarding seed legislations must reach farmers also to make them aware of their rights.

The Indian seed industry is expected to grow very rapidly in the coming years. There are several grounds for expecting that the seed industry will coalesce under the control of a few large companies with foreign interests. Firstly hybrid seed is produced principally by large companies and its use is set to increase following the decline of the public sector for various reasons. Secondly, smaller companies will find it increasingly difficult to compete because the market is fickle. Moreover, the plant variety protection regulations will scotch a market in second and subsequent generations. Thirdly, there will be increased use of transgenic crops which are produced only by those companies which can meet the high development costs.

Key gaps and strategic interventions

Gaps

Need to promote seed exports

Gaps in IP protection and regulation

Need to strengthen seed delivery system

Need to increase focus on new variety development

High cost of vegetable crop seeds:

Stringent import regulations

Strategic interventions

Setting up seed production hubs : Currently, there are no dedicated seed production hubs in India. Setting up dedicated seed production hubs can lead to focused efforts in sector development. Inclusion of the private sector is necessary for the successful operation of these hubs, as it can bring in the necessary expertise to the sector. Government incentives for investment in these hubs can help attract private players.

Export orientation : As mentioned, India has huge scope for promotion of seed exports and requires efforts in this area. The seed production hubs can be oriented towards exports by establishing an export promotion wing. The functions of this wing may include global seed trade assessment, thorough understanding and tracking of seed import requirements across geographies, and consequently, alignment of the seed production as per import requirements.

Strengthening of Seed Village Programme : Strengthening the Seed Village Programme will improve seed delivery. Seed subsidies for high yielding variety and hybrid seeds may be given to farmers at specified intervals, so that the maximum number of farmers gain access to newly developed seeds.

Seed Cost Rationalisation: In the present system for vegetable hybrids, the varieties and hybrids developed by ICAR-SAUs are given to private sector seed companies at nominal rates of royalty. By providing breeder seeds on cost basis to public sector seed organizations, they may be able to produce vegetable seeds on a large scale and provide to farmers at reasonable prices. ICAR-SAUs should also provide variety- wise package of practices for vegetable seed production and technology, along with breeder seeds.

Improving seed traceability : To control the distribution of spurious seeds, improving seed traceability is an important measure that needs to be in place. Using a barcode or Quick

Response (QR) Code could be one method. Using these unique codes could help in strengthening seed traceability and enable farmers to track the origin of the seed before purchasing. Besides deterring spurious seeds, it could also help in tracing their origin in case of quality issues.

CONCLUSIONS

Boost in seed industry both private and public sector

Increase in seed infrastructure

Improvement in seed import and export

Seed storage and conservation is made easy and more profitable by seed law

Higher quality and quantity of seed produced and distribution is possible

The good quality seed has high return per unit area as the genetic potentiality of the crop can be fully exploited.

Minimization of seed/seedling rate i.e., fast and uniform emergence of seedling.

The quality seed respond well to the applied fertilizers and nutrients.

Uniform in plant population and maturity.

Yield prediction is very easy.

Handling in post-harvest operation will be easy.

Preparations of finished products are also better.

High produce value and their marketability.

Doubling the famers income level is possible with impact of seed legislation is implemented in *letter n spirit*.

ROOT BORDER CELL : A BLUE PRINT TO DEFENSE PLANT—AN OVERVIEW

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Plants have different defense mechanisms to prevent infection by soil-borne pathogens. One such defense mechanism is achieved by border cells and their exudates (Hawes *et al.*, 2000). The fact that root cap cells in higher plants have been shed and died is traditionally believed to be due to friction between the root tip and the soil during root tip growth. Therefore, in the past, these detached and dead cells were called "shed root canopy cells" and were mistakenly considered as a byproduct of the constitutive transformation of the root canopy, which was not biologically feasible and lubricated the advancing roots. The tip acts as a root and enters the soil. Recently, more and more evidence shows that exfoliated root cap cells have biological vitality (> 90%) in many higher plant species. These exfoliated root cap cells are genetically regulated and play a role in plant growth and development. It plays multiple defense roles in the process. Therefore, traditional perspectives have encountered new challenges. Hawes and Lin (1990) first referred to these exfoliated root crown cells as root border cells to emphasize that they constitute a biologically feasible border between the root surface and the soil. Border cells are living plant cells generated on the root canopy, forming a cell sheath that surrounds and protects the root canopy, and is characterized by their separation from the root canopy upon contact with water. With the help of a stereoscope, you can see the separation of border cells.

The number of root border cells per root varies among plant families. *Gossypium hirsutum* (Malvaceae) release 8,000-10,000 border cells per 24 hours. The members of family Solanaceae release 100 border cells per day per root (Hawes *et al.*, 2003). On other hand, the member of family Brassicaceae releases no border cells. Vicre *et al.*(2005) suggested that in the members of Brassicaceae, the root tip does not produce border cells as such, rather, these produce and release cells which remain attached to each other and form a block of several cell layers called "border like cells".

The roots of many plants are known to produce a large number of "border cells", which play a central role in protecting the roots in the rhizosphere. Border cells (formerly known as "shedding root crown cells") are defined as "those cells that are separated from each other and loosely bound to the roots so that they disperse in suspension when the root tip is immersed in water" (Hawes and Lin, 1990). However, this definition was later modified as follows: "Border cells" are those cells that are separated from the root tips of higher plants and dispersed in suspension immediately after contact with water (Hawes *et al.*, 2000). Root border cells have been implicated in protecting roots from injury and infection. Border cell separation has been shown to occur in the presence of water, and they remain viable even after cells are separated from the root tip.

The root cap releases a variable number of border cells that protect plant species. A single radicle tomato, pepper, corn, and cucumber will produce a set of 20, 90, 2700, 3000, and 3800 border cells, respectively. The formation and loss of these cells from the root crown region is a developmentally regulated process that is also controlled by plant hormones and environmental factors. However, because these cells are wrapped in a layer of mucus, they remain tightly attached to the root tip. In the absence of free water, border cells adhere tightly to the apex that produced them. By contact with water in the soil (from rain or irrigation), the mucus swells and disappears, and the border cells are released into the external environment. Like leukocyte granules, border cells contain abundant storage granules that provide energy for survival and signal responses in the extracellular environment (Feldman, 1985)

Almost all plant species produce and release a large number of metabolically active border cells in the rhizosphere. These may remain viable for upto three months on agar and for one week or more in the rhizosphere. Thus, these have the potential for interaction with rhizosphere micro-organisms.

Border cells production : The number of root border cells per root varies between plant families. Cotton (Mallow)

releases 8,000-10,000 border cells every 24 hours. Members of the Solanaceae family release 100 marginal cells per stem per day (Hawes *et al.*, 2000). On the other hand, members of the Cruciferae do not release border cells. Vicreet *et al.* (2005) argue that among members of the family Brassicaceae, their root tips do not produce border cells like this. Instead, they generate and release cells that remain attached to each other and form what is called a "border-like cell" blocks of several cell layers.

The generation of border cells depends on the type of root tip meristem. Border cell production, release, and RAM organization types are retained in the taxonomy unit. This observation raises the idea that the ability of border cells to produce and release may be related to the type of RAM tissue. It was found that species with open RAM (substantially open or intermediate open) tissues produced much more border cells than species with closed tissues (Hamamoto *et al.*, 2006).

The production of border cells showed a response to increased CO_2. Xiaowen *et al.* (2000) studied the stimulating effect of increased carbon dioxide levels on border cells. They observed that during germination, a high CO_2 and low O_2 atmosphere inhibited root development and border cell separation of pea seedlings. In subsequent developments, the same atmospheric composition stimulated the separation of border cells without significantly affecting root growth. Increased CO_2 rather than low O_2 was responsible for the observed stimulus of peripheral cell numbers. They concluded that higher CO_2 could obviously replace endogenous signals that regulate the number of border cells released from pea roots to the rhizosphere. The same conditions that stimulate edge cells in peas do not have this effect in alfalfa. The release of peripheral cells is regulated by the mechanical action of water in the soil and by plant hormones (Zhao *et al.*, 2003).

Function of root border cells : Border cells are thought to play an important role in plant defense. The recently discovered border cell response to fungi, nematodes and aluminum suggests that border cells may play a new mechanism to protect root tips from biotic and abiotic stress. Pan *et al.*, (2002) studied the developmental regulation and biological function of root border cells in higher plants, and concluded that once the border cells detached from around the root cap, their metabolic activity will be based on the expression of genes different from those in the root cap. Dramatic increase. Two genes related to early and late development, PsUGT1 and RCPME1, were cloned and functionally identified. They also concluded that border cells export a variety of chemicals, including anthocyanins, antibiotics, special enzymes, and substances that inhibit or promote other entities in the rhizosphere, such as bacteria, fungi, viruses, and nematodes; and antagonize soil roots Some toxic chemicals around the tip, such as the toxicity of aluminum. Stacy *et al.* (2015) studied altering carbon transfer from the roots: in response to the rapid, sustained inhibition of the spread of border cells by compost water extract (CWE), and reported the effects of root sheath infection on the roots around each apical The degree of protection is 95%.

Role of border cells in managing abiotic stress : Susan and Martha (2001) studied the possible role of root border cells in detecting and avoiding aluminum (Al) toxicity, and concluded that the anti-aluminum mechanism that works at the entire root level also plays a role at the cell level of border cells effect. They also observed that aluminum induced a thickening of the mucus layer around the border cells separated by two bean beans (*Phaseolus vulgaris*) and shelled beans (cv Dade and cv Romano). They concluded that after 8 hours of treatment, border cells had a thicker mucus layer in response to 25µM Al in the Dade variety compared to Cv Romano cells, a phenomenon that preceded the observed variety in the relevant cell viability Differences. They also suggested that the release of aluminum-bound mucus by border cells may play a role in protecting root tips from aluminum-induced cellular damage.

Role of border cells role in biotic stress : *Aphanomyces euteichesis* is an oomycete plant pathogen that can cause devastating diseases of whole legume-specific legumes, including alfalfa (*Medicago sativa*), common beans (*Phaseolus vulgaeis*), and peas (*Pisums ativum*). Cannes *et al.* (2011) investigated the association between borderline cell responses and local root infections of the pathogenic *Aphanomyces euteiches*. They observed that root infections started in the extension, rather than the root crown and border cells. After root cell inoculation, its size and morphology will change, which will significantly increase the yield of border cells. The stimulating effect of *Aspergillus flavus* on border cells depends on the number of oocysts inoculated. Interestingly, border cells respond to the attack of pathogens by increasing the synthesis of phytoalexins, new hormones. They concluded that the unique response to *Aspergillus vulgaris* inoculation occurred at the level of root tissue. These findings indicate that the root border cells of the pea are involved in the local defense of the root tip against Monascus. Root border cells

constitute a convenient quantitative model for measuring the molecular and cellular basis of plant-microbe interactions.

Defense Mechanisms by Border Cells : Border cells function by protecting the root tip, which protects the health of the plant. The root tip has root meristems, and all new cells come from root meristems (Hawes *et al.*, 2000). Root tip and border cells are important to plants because they interact with microbial populations in the rhizosphere. For example, the generation of root border cells is positively correlated with root colonization of beneficial organisms such as arbuscular mycorrhiza. In addition, Tsai and Phillips (1991) found that flavonoids in root exudates of alfalfa (alfalfa) can promote spore germination, mycelial elongation and branching in vesicular-arbuscular mycorrhizal *Glomustunicatum*. In addition, Arriola (1997) found that the mycorrhizal fungus Glomusintrar *adices* was positively related to the maximum border cell yields of the four genera of the four genera Mar (*Gomphrena globosa, Amaranthus tricolor, Amaranthus caudatus* and *Celosia cristata*)

In addition, root border cells may attract pathogenic microorganisms as a 'decoy' defense mechanism. For instance, nematodes are attracted toward border cells, but after 20 - 30 min of interaction, nematodes are immobilized in response to exudates released by border cells. After hours or days, nematodes regain their vigor. By that time, the growing apex was freed from the danger of infection (Zhao *et al.*, 2000). Root border cells have a similar defense mechanism against pathogenic fungi. Gunawardena *et al.* (2002) observed that fungal spores of N. coca (mating population VI) were located in the border cells of pea (*P. sativum* L.). As a result, a "mantle" is formed between border cells, their secretions and fungal hyphae (Gunawardena *et al.*, 2002). The mantle sheds spontaneously, allowing the uninfected root tip to continue to grow, thereby avoiding infection. The new border cells immediately begin to regenerate, forming new boundaries within 24 hours, providing new protection for the growing apex. A similar response was shown when the apex was in adverse abiotic conditions (such as aluminum or high carbon dioxide levels). Recent findings have revealed the mechanism by which border cells may prevent fungal spore infections. When treating about 120 proteins secreted by the pea root tip (root cap "secretome") with protein degrading agents, the infection rate of the pea pathogen *N. haematococca* increased from less than 5% to 100%. Analysis of multidimensional protein identification techniques has shown that border cells secrete many different proteins, including those involved in plant defense mechanisms (Wen *et al.*, 2007).

Extra-cellular DNA (Ex-DNA) : Wen *et al. (*2009*)* proposed that Ex-DNA is required for root tip resistance to fungal infection and reported that exDNA is a component of root cap slime and that exDNA degradation during inoculation by a fungal pathogen results in loss of root tip resistance to infections. DNase treatment reverse trapping and impairs defense, and mutation of pathogen DNase results in loss of virulence Most root tips (>95%) escape infection even when immersed in inoculum from the root-rotting pathogen *Nectriahaemato cocca.* By contrast, 100% of inoculated root tips treated with DNaseI developed necrosis. Treatment with BAL31, anexonuclease that digests DNA more slowly than DNaseI, also resulted in increased root tip infection, but the onset of infection was delayed. Control root tips or fungal spores treated with nuclease alone exhibited normal morphology and growth. Pea (*Pisumsativum*) root tips incubated with ^{32}P dCTP during a 1 hour period when no cell death occurs yielded root cap slime containing ^{32}P-labelled exDNA. This ex-DNA seems to function in root defence in a way similar to NETS *i.e.*Neutrophil extracellular traps system Wen *et al.*,2007.

CONCLUSIONS

Border cells are the basis for plant-microbe interactions. In the rhizosphere, border cells are important not only to assist the growing roots to penetrate the soil, but also to provide a protective layer for pathogens around the root tip. Various studies have provided convincing evidence that border cells play an important role in protecting roots and entire plants. First, the response to the pathogen increases the number of border cells. Studies on plants cells clearly show that they can (1) secrete various defense molecules and (2) provide protection against pathogens. Second, border cells can attract, avoid, or repel pathogenic microorganisms. Third border cells are also capable of producing defensive molecules. Another interesting role of border cells is their ability to attract and immobilize parasitic nematodes, thereby limiting root infection.

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QUINTESSENCE SHIFT IN BREEDING STRATEGIES COVERING CROP COLONIES AND CLIMATE ANALOG SITUATIONS : OPPORTUNITIES AND RISKS

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Abstract

Traditional breeding strategies, suiting agroclimatic zones either to state or to country are the propensity. With time, there is no much changes registered in breeding strategies. However, breeding through molecular markers is the change that has been registered. But successful of product development through this approach is less realized and more often criticized for huge investments which have yielded several thousands of papers on basic research. However, the applied aspects are not much encouraging. The corporeal procedure includes development of breeding lines which are high yielding in addition to have traits such as disease resistance, early maturing, and high nutritional components etc which not only depends on crop but also depends on specific objectives. Intriguingly, varieties or hybrids or transgenic developed employing different breeding procedures such as selections, hybridization, mutation or molecular breeding are first tested at a locality within an agroclimatic zone, for two-three years, along with parents/local checks. If established superior over checks/parents shall get promoted to Multi Location Trials; identifying a few locations within an agroclimatic zone or across agroclimatic zones. The pooled data of the performance of the breeding line shall be analyzed and if found better and stable shall get promoted to Farm Trials. The variety/hybrid will be tested on a larger scale in farmer's plots either through Agriculture Department or directly under participatory approach. Simultaneously the entry is submitted to ICAR – AICRP set up to get tested across several locations surpassing varied agroclimatic zones in the country. There shall be two levels (IVT and AVT) of testing and if found superior with yield advantage over checks, shall get released at large for cultivation, considering its superiority, either suiting entire country or to a very specialized zones through Central Varietal Identification Committee. Almost in a similar way, it also can get released from State Varietal Committee, by following the procedure. This activity is found to be laborious and time consuming; almost 10-15 years are necessarily required to develop a variety. It is interesting that in the light of new policy based concepts of crop colonies and climate analogs, the time for varietal development if likely to get shortened. In fact, farming community shall get benefit at a faster rate than the traditional breeding methodology.

Crop colonies are concepts which has been developed and also being implemented by Telangana State where vegetable growing areas, in the state, are being mapped for productivity. Demarcating those areas where the crop can yield better are encouraged while in those areas where there is no yield advantages are either banned (regulated by Govt. policy) or attempts shall be made to enhance the productivity. The ultimate goal is to achieve sustainability and self sufficiency. In this approach there is no breeding attempts but to test several varieties/hybrids which can suit those environments and directly releasing to farming community. One of the approaches includes mapping the entire state for crop patterns which have evolved and persisting. However, areas shall be marked where the productivity is good and the crop shall not be allowed to spread to other areas. One such negative impact in Karnataka is Tur have lost sizable area for Bt cotton cultivation. This will reduce production of Tur and make the state non-sustainable. However, for fulfilling the needs of dhal, Karnataka has to spend extra amount for importing from neighboring areas. Strict regulation shall help the state to achieve self-sufficiency Another concept which has slowly gaining importance is climate analog varieties. Instead of creating new lines, it is possible to look for already released varieties or those which are in pipe line considering the similar climatic situations. One such attempt has been made in Telangana when Soybean varieties of the state were not performing; some varieties which have been bread in similar climatic conditions from Madhya Pradesh were tested directly in the state. It was interesting that these varieties have performed much better than the original place. Testing for a few seasons such as kharif, rabi or summer, if found better and suitable, can be released directly for commercial cultivation. This will not only reduce the cost but also benefit largely the farming community. Looking into these new ideas, there is a large scope for replicating across crops hence reduces the cost and time. Only risk could be carriage of any epidemic diseases or pests from other regions can be detrimental. One such case was reported in Cluster bean in Karnataka. With an intension of promoting for gum, a few varieties from Rajasthan were barrowed and suggested for commercial cultivation. A high level enthuse of farmers could help in covering in large areas in a very short time because of commercial value for the gum. This has resulted in epidemic form of powdery mildew which almost devastated the crop hence was a set to the entire attempt of popularizing the gum guar in the state. It can also be an issue of "ethics of breeding" in a negative way.

Abstracts

INFLUENCE OF FOLIAR APPLICATION OF MICRO NUTRIENTS ON MORPHO-PHYSIOLOGICAL AND BIO PHYSICAL PARAMETERS FOR ENHANCING THE PRODUCTIVITY IN BT COTTON

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Abstract

Micronutrients deficiency in cotton increases abscission of boll and finally affects the yield of cotton and are directly related to physiological process in plant and helps in increasing the production by improving the reproduction phase. External supplementation of plant nutrients needs to be therefore emphasized keeping in view their role in improving yield. Micronutrients play an important role in physiology of cotton crop and these are being a part of enzyme system or catalyst in enzymatic reactions. They are required for plant activities such as chlorophyll formation, photosynthesis, transpiration rate and proline synthesis. A field experiment was conducted to study the effect of foliar application of micro nutrients on morpho-physiological, bio-physical and bio-chemical parameters for enhancing the productivity in Bt Cotton at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka. The experiment consists of nine treatments *viz.*, $FeSO_4$, $ZnSO_4$, $MgSO_4$, $MnSO_4$, Boron and combination of $MnSO_4$ + $ZnSO_4$, $MgSO_4$ + $ZnSO_4$ and $FeSO_4$+ $ZnSO_4$ foliar spray of all these at 70 and 90 DAS. The experiment was laid out in randomized block design with three replications. Among all the treatments, foliar application on micronutrients with $MgSO_4$ 1% + $ZnSO_4$ 0.5% at 70 and 90 DAS recorded significantly highest plant height, monopodial,sympodial, total dry matter production, number of bolls per plant and seed cotton yields as compare to other treatments. It was on par with the treatments $FeSO_4$ 0.5% + $ZnSO_4$ 0.5% and treatment $MgSO_4$ 1% and the minimum yield and yield components were recorded under control. Significantly highest seed cotton yield (2393 kg ha^{-1}) was recorded in foliar spray with $MgSO_4$ 1% + $ZnSO_4$ 0.5% compare to control (1788 kg ha^{-1}). The foliar application of $MgSO_4$ 1% + $ZnSO_4$ 0.5% recorded higher biophysical parameters *viz.*, Photosynthetic rate, Transpiration rate, Relative water content compare to control. Among all the treatments $MgSO_4$ 1% + $ZnSO_4$ 0.5% recorded higher Chlorophyll content and proline content compare to control. It is concluded that, application of foliar spray with $MgSO_4$ 1% + $ZnSO_4$ 0.5% at 70 and 90 DAS more effective in increasing the yield in Bt- cotton as compare to other treatments.

GENOTYPE X ENVIRONMENT INTERACTION FOR SEED YIELD AND ITS COMPONENTS IN TRITICALE AND WHEAT GENOTYPES UNDER OPTIMUM AND STRESS ENVIRONMENTS

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Abstract

Triticale (*Triticosecale)* is a hybrid of wheat (*Triticum*) and rye (*Secale*) which combines the yield potential and grain quality of wheat with the disease and environmental stress resistance of rye. The triticale is an allohexaploid (AABBRR) with A,B genomes from wheat and R genome from Rye. A set of 30 genotypes consisting of wheat (aestivum and durum) and triticale were raised in randomized block design with 3 replications under three environments (Normal (six irrigation), Saline (six irrigation of 4Ec) and Stress (three irrigation)) during 2016-17 at Bikaner, Rajasthan, India. The climate of Bikaner region is typically semi arid which is characterized by extremes of temperature during summer and winter with aridity of atmosphere and salinity of rhizosphere. Therefore the study was undertaken to identify the genotypes with high yield stability across the normal ,saline and stress environments in particular. G × E interaction was significant for all the characters studied. E + (G × E) and E linear sum of squares were highly significant for all the characters indicating differences between the environments and their considerable influence for all the characters. On the examination of stability parameters for different genotypes, it was concluded that triticale genotypes T-4037 and T-4046, and wheat genotypes RAJ 4083, and

RAJ-3077 possess average stability and suitable for all types of environments, while genotypes T-4045, RAJ 4079, WH-1105 appeared promising for different traits in stress environments ,hence could be utilized in future breeding program. Thus it can be concluded that both predictable (linear) and unpredictable (non-linear) components contributed significantly to the differences in the stability of genotypes. Therefore, it might be suggested that the stability for seed yield in these high yielding genotypes was mostly imparted by the stability of other traits.

DEVELOPMENT AND DEMONSTRATION OF CLIMATE RESILIENT AGRICULTURAL TECHNOLOGIES IN RAINFED ECOSYSTEMS OF *SHIWALIK* FOOTHILLS OF NORTH-WESTERN HIMALAYAS

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Abstract

Rainfed subtropics of Jammu and Kashmir are characterized by undulating and rugged topography, coarse textured soils with shallow to medium depth having low moisture retention capacity, stoniness and degraded lands with poor soil fertility and low in organic matter content. Major cropping systems of the region comprised of maize-wheat, maize-chickpea, maize-mustard and blackgram-wheat. Soil moisture scarcity at one or another crop growth stages is a frequent phenomenon and is the most critical constraint adversely affecting crop productivity. Attempts have been made under All India Coordinated Research Project on Dryland Agriculture (AICRPDA) and National Innovations on Climate Resilient Agriculture (NICRA) at SKUAST-Jammu, Rakh Dhiansar to evolve climate resilient agricultural technologies with better coping mechanism not only to offset the adverse effect of aberrant weather situations on crops but to improve the crop productivity. Several climate resilient technologies have been generated such as high input responsive high yielding maize hybrid, efficient intercropping system, highly productive cropping systems, most efficient alternate land use systems, tillage and the nutrient management for resource conservation and improving soil fertility, foliar application of nutrients to offset dry spells, real time contingency plans to address aberrant weather situations, energy management through custom hiring for timely farm operations and rainwater harvesting (*in-situ* and *ex-situ*) and its efficient use. These technologies have been found to be appropriate in terms of increasing productivity of the crops by optimizing the resource use even under varying degrees of abnormal weather conditions. All the technologies have been generated at the AICRPDA, SKUAST-Jammu, Rakh Dhiansar and also have been validated through multiple demonstrations on farmer's fields.

DIVERSITY STUDY FOR GRAIN YIELD AND ITS PARAMETERS IN LENTIL (*LENS CULINARIS* L. MEDIK.) IN BIHAR, INDIA

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Abstract

Genetic divergence was assessed amongst 140 germplasm lines of lentil collected from different districts of Bihar, GBPUAT, Pantnagar and IIPR, Kanpur and ICARDA, Lebenon. Experiment was conducted at Bihar Agricultural University, Sabour, Bhagalpur. The genetic divergences of all the 140 genotypes were estimated using Mahalonobis D^2 statistics. Treating D^2 as the square of generalized distance, all genotypes were grouped into a number of clusters. All the genotypes included in the present investigation, were indigenous and exogenous. Genetic variation among traits is important for breeding and in selecting desirable types. On the other hand, an analysis of the correlation between seed yield and yield components is essential in determining selection criteria;

however, path coefficient analysis helps to determine the direct effect of traits and their indirect effects on other traits. The purpose of this study was to estimate the total genotypic variability, correlations, and path analysis among some important traits for selection criteria for improving yield in timely sown lentil. These genotypes were grouped into 5 clusters. Cluster I was found to be the largest comprising 121 genotypes, followed by cluster III having 12 genotypes. Cluster II, IV had three genotypes each and V was monogenic. The characters viz. number of seeds per plant, days to maturity and total number of pods per plant contributed maximum towards genetic divergence amongst the genotypes and supposed to play an important role in the improvement of lentil. On the basis of cluster mean, intra and inter cluster distance and per se cluster III, IV and V may be used for their desirable characters in breeding programme of lentil. Selected entries could be intercrossed to obtain high heterotic effect and also to recover desirable transgressive segregants.

GENETIC ENGINEERING IN CROP IMPROVEMENT

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Abstract

Genetic engineering, also called genetic modification or genetic manipulation, is the direct manipulation of an organism's genes using biotechnology. It is a set of technologies used to change the genetic makeup of cells, including the transfer of genes within and across species boundaries to produce improved or novel organisms. New DNA is obtained by either isolating or copying the genetic material of interest using recombinant methods or by artificially synthesizing the DNA. A construct is usually created and used to insert this DNA into the host organism. The first recombinant DNA molecule was made by Paul Berg in 1972 by combining DNA from the monkey virus SV40 with the lambda virus. As well as inserting genes, the process can be used to remove, or "knock out", genes. The new DNA can be inserted randomly, or targeted to a specific part of the genome. Genetic engineering has been applied in numerous fields including research, medicine, industrial biotechnology and agriculture. Crops that are resistant to herbicides can also provide higher yield as the farmer can reduce the number of competing weed species in the field. Future potential for genetic engineering of crop plants could influence the yield of the plant, require less water or increase nutrient content.

DEVELOPMENT OF MALE STERILITY BASED POWDERY MILDEW RESISTANT HIGH YIELDING F_1 HYBRID IN CHILLI (*CAPSICUM ANNUUM* L.)

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Abstract

The required goals of increasing productivity in the quickest possible time can be achieved only through heterosis breeding which is feasible in chili crop. Exploitation of natural out crossing could render commercial hybrid seed production technology economically viable through use of male sterile lines. Powdery mildew of chili incited by *Leveillula taurica* is one of the most serious diseases of chili. Chili production in India is responsible of heavy yield loss ranging from 14 to 30 per cent. The use of systemic fungicides for control is not effective. Besides this, its indiscriminate use causes pathogen resistant strains development. Perfect solution to keep disease away from the crop is to develop resistant variety/hybrid. Among the limited commercial hybrids available in chili none is resistant to powdery mildew. Heredity studies of *Capsicum annuum* showed that resistance to powdery mildew is dominant and polygenic. Hence, it may be possible to develop high yielding hybrids resistant to powdery mildew. The present study was conducted for commercial exploitation of powdery mildew resistant hybrid in chili. Two geno-cytoplasmic male sterile lines GCMS lines of chili and 10 fertility restorer were used for development of hybrids and screening for resistance to powdery mildew. 20 hybrids were produced during 2010-11 using line x

tester design. Station and multilocation trials were conducted using Completely Randomized Block Design with three replications during 2011-12 to 2013-14 and 2014-15 and 2015-16 respectively at University of Agricultural Sciences, Raichur, Karnataka, India. The promising hybrids were recommended for release by conducting farm trials during 2016-17. All of these sterile and restorer lines and 2 best hybrids were screened in natural epiphytotic conditions for powdery mildew resistance during 2018-19. The GCMS based hybrid UARChH42 registered significantly highest mean dry fruit yield (4900kg/ha) over non GCMS based hybrid Sitara (3936kg/ha) in station trials. Multilocation trials were conducted over three locations and found that hybrid UARChH42 recorded significantly highest mean dry fruit yield of 4248kg/ha over standard non GCMS based check hybrid sitara (2272kg/ha). The high yielding hybrids were tested by conducting 6 large scale demonstrations and 17 farm trials in farmer's field and found that the hybrid UARChH42 registered highest average dry fruit yield of 3495kg/ha over check hybrid Sitara (3025kg/ha) which was 15.53 per cent superior. None of the male sterile lines, restorer lines and hybrids screened for powdery mildew disease was found to be Immune (I) in reaction in natural epiphytotic conditions. However, one sterile line JNA1, one maintainer line JNB1 and one hybrid UARChH42 were found to be highly resistant and one restorer line BVC42 and one hybrid UARChH43 found to be resistant reaction to powdery mildew. The hybrid UARChH42 recorded significantly highest mean dry fruit yield in station trials and multilocation as well as farm trials indicating the stable performance of the hybrid over the year and the location. Hybrid UARChH42 and UARChH43 showed highly resistant and resistant reaction to powdery mildew respectively because of the high resistance of the male sterile line used to produce hybrid UARChH42 and the resistant male parent used to produce both hybrids. These results indicate that inheritance of resistance to powdery mildew is dominant. Both the resistant hybrids developed are useful to the farming community to boost the chili yield in commercial level.

INTENSIVE INTEGRATED FARMING SYSTEM MODEL FOR LIVELIHOOD SECURITY OF SMALL FARMERS IN TUNGABHADRA COMMAND AREA OF KARNATAKA

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Abstract

Sustainable agriculture represent an integrated approach to increasing farm yield and managing resources in order to address all three critical aspects of sustainability: economic, environmental and social. The integrated farming system (IFS) approach has multiple objectives of sustainability, food security, farmer security and poverty reduction. It involves use of outputs of one enterprise component as inputs for other related enterprises wherever feasible. In Tungabhadra Command Area (TCA) the existing farming system comprising of crops plus dairy accounts to the tune of 80 percent with a estimated gross return of Rs. 55672/ha and crops plus horticulture accounts for 10 percent with estimated gross returns of Rs.62344.This income is being the lowest under irrigated condition and employ the family member round the year is need of the hour. In this view the present investigation was carried out at Agricultural Research Station, Siruguppa, Karnataka with the following objectives. viz., to develop integrated farming system model for livelihood security of small farmers and to develop efficient and economically viable IFS models. IFS model was established at Agricultural Research Station, Siruguppa under AICRP on Integrated Farming System during the year 2010-11 on an area of 1.0 ha. Siruguppa is located at 15^0 38^I N latitude and 76^o 54^I E latitude with a mean sea level of 380 MSL. It received an average rainfall of 453.6 mm from 2011-12 to 2017-18 and it comes under semi-arid climate. The land was allocated under different components of IFS *viz.* Crop components, Horticultural components, Animal components including dairy and goatary, vermicomposting, composting and boundary plantation. The different cropping systems *viz*., paddy-paddy, paddy–maize, paddy–sorghum, Bt cotton-green manuring, maize-chickpea on an area of 0.74 ha, horticulture (Sapota+Curryleaf+floriculture) on an area of 0.20 ha with kitchen garden and fodder, farm pond, animal shed, goat shed, farmhouse with including vermicompost and compost cover an area of 0.06 ha. The goatary unit was incorporated to the IFS model during the year 2012-13. Apart from these the boundary plantation with *Teak* and *Glyricidia* was taken up and also internal bunds are planted with pigeon pea, banana, fig and fodder crops to meet

out the nutritional security of the small family. The results over seven years i.e. from 2011-12 to 2017-18 indicated that higher System Equivalent Yield (SYE) of 29.05 t/ha was observed during 2014-15 when compared to initial year of 2011-12(10.75 kg/ha). Three fold increases in SEY (29.05 kg/ha) was observed in 2015-16 when compared to 2011-12 (10.75 kg/ha) with an average SEY of the IFS model was 21.51 t/ha. The gross returns, net returns and B:C ratio from 1ha for seven years i.e. from 2011-12 to 2017-18 varied from Rs 187576 to 360980, Rs. 95878 to 218426 and 1.93 to 2.53 with an average of Rs. 329133, Rs. 184344 and 2.29, respectively and these were increased with years except during 2014-15. Among the different components, over a period of seven years, the animal component realized the higher gross returns followed by crop component and lowest being the horticulture component. However, the net return being highest in crop component followed by animal component and lowest being same as in case of horticulture component. Apart from monetary benefits, the IFS model generated average of 471.3 man days. The results over period of seven years suggested that model is economically viable and sustainable.

INFLUENCE OF GENOTYPES, PACKAGING MATERIALS AND BOTANICALS ON LONGEVITY OF PIGEON PEA [*CAJANUS CAJAN* (L.) MILLSP.] SEEDS UNDER AMBIENT STORAGE CONDITIONS OF KANPUR, UP, INDIA.

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Abstract

An investigation entitled "Influence of genotypes, packaging materials and botanicals on longevity of pigeon pea [*Cajanus cajan* (L.) millsp.] seeds under ambient storage conditions of Kanpur, UP, India" was carried out in the Department of Seed Science and Technology, Kanpur with a view to assess the influence of different genotypes, containers and botanicals on seed quality of pigeon pea during prolonged storage period. During 2017-18, seeds of two pigeon pea variety viz. Pusa 991(short duration) and Amar (long duration) was procured from Seed Processing Unit of the University and treated with eight botanicals namely Neem formulation @ 1.5 mg/kg seed (T_2), Citronella oil @ 5 ml/kg seed (T_3), *Trichoderma viridae* @ 10 g/kg seed (T_4), Neem leaf powder @ 10 g/kg seed (T_5), Lantana leaf powder @ 10 g/kg seed (T_6), Kali tulsi leaf powder @ 10 g/kg seed (T_7), Turmeric powder @ 2g/kg seed (T_8), Mustard oil @ 2 ml/kg seed (T_9) ; one each of chemical formulation viz. Deltamethrin @ 0.04 ml/kg seed (T_1) and Carboxin + Thiram @ 3 g/kg seed (T_{10}) and untreated control (T_0) and mixed uniformly. Treated and untreated lots were packed in porous bag (P_1) and nonporous bag (P_2). The porous bags were sealed carefully to make it air tight. All the bags were placed under ambient conditions of storage and samples for seed quality determination were taken out from each bag at every two months interval. The observations were recorded on standard germination per cent, seedling length (cm), seedling dry weight (mg/10 seedlings), seed moisture content per cent and insect infestation per cent. Before packing, seeds were dried to eight per cent for storing in porous and nonporous bags both. The experimentation was done following the standard procedures. A critical analysis of data reveals that the genotype, container, botanicals and their interaction had significant effect on all the parameters studied except first order of interaction (V×P) and second order of interaction (V×P×T) with respect to standard germination per cent and insect infestation per cent. A significant differences among the genotype, containers, botanicals and their interaction were observed during entire period of storage except a few cases. A progressive decrease in standard germination, seedling length and seedling dry weight were noticed. At the end of storage period maximum abatement in control (T_0) and least in treatment turmeric powder (T_8) and in interaction of V_1P_2, V_2P_8, V_1T_8, V_2T_8, P_2T_8 were observed. The genotype Amar and nonporous packaging material showed its superiority over genotype Pusa 991 and porous packaging material over entire period of storage with respect to standard germination, seedling length and seedling dry weight. Though highest standard germination (79.188%) were observed in treatment deltamethrin (T_1) at 10 months storage which was at par to treatment turmeric powder (T_8). The maximum seedling length (24.89 cm) and seedling dry weight (0.364 mg/10 seedling) were recorded in T_8 (turmeric powder) followed by deltamethrin (T_1) at 10 months storage. nonporous bag showed better performance as compared to cloth bag by scoring highest values for all parameters except insect

infestation and moisture content where it were least. The genotype Amar, nonporous bag and Treatments-deltamethrin (T_1), neem formulation (T_2) and Termeric powder (T_8) had had maintained standard germination above MSCS level for 10 months storage period. Looking at overall picture of results, it is concluded that nonporous bag (P_2), botanical-turmeric powder (T_8) and chemical deltamethrin (T_1) and their combination may be recommended for safe storage of pigeon pea variety Pusa 991 and Amar under ambient storage condition of Kanpur.

GENETIC VARIABILITY, HERITABILITY AND GENETIC IN PEARL MILLET GERMPLASM

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Abstract

Pearl millet is one of the most important crops in the world because it can adapt to a variety of ecological conditions and is suitable for low-input cultivation and multiple uses. It is called the poor's crop because it is one of the main staple foods for the poorest and most food-insecure people in the world, and has the potential to be used as food or feed. It also meets the requirements of various biotic and abiotic stresses. The experimental material comprising of 320 germplasm lines of pearl millet along with four checks. The mean squares due to blocks were highly significant for days to 50 per cent flowering and ear head width. The mean square due to treatment, check and germplasm were highly significant for all the characters except mean square due to checks for ear head length. The mean square due to check v/s germplasm was also highly significant for all the characters except leaf width and ear head width. Highest GCV and PCV values were observed for grain yield per panicle followed by plant height, ear head width, ear head length and number of leaves. High heritability conjugation with high genetic advance (as percent of mean) observed for grain yield per panicle, 100-seed weight, plant height, ear head width, ear head length, number of leaves and days to 50 flowering, indicate additive genetic control in the inheritance of these traits and selection pressure could be profitably applied on these characters for yield improvement.

ROLE OF WOMEN IN INDIAN POLITICAL SCENARIO

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Abstract

Many women remained politically active in India before or after independence. Their political role has also been important. But when it comes to female participation in politics, the figure are shocking. Women have always lagged behind men, either directly or indirectly (as voters) at both levels. Many times, it also said that only aspiring women or the women from political background are active in politics. The situation of women globally ranks 141 out of a total of 193 countries, while in India (as of 2011) there are 58.64 crore women as against 62.37 crore men. Talking about the whole world, there are about 60 million more men than women all over the world at this time. Before Independence, in the India for the first time in 1917, there was a demand for participation of women in politics after which in 1930 women got the opportunity of vote for the first time. In the first central government after independence (Nehru), only one woman (Rajkumari Amrit Kaur) in 20 cabinet minister, who was given health department. Lal Bahadur Shastri and even Indra Gandhi did not have a woman minister in the 5th,6th & 9th Lok Sabha. Mohsina Kidwai was the only woman in Rajeev Gandhi's cabinet. The situation has improved slightly in the Modi's government. There are 6 women in 23 cabinet ministers in the 16th Lok Sabha and 3 women out of 24 ministers in the 17th Lok Sabha. This situation is in the Lok Sabha, the same situation is there in the Rajya Sabha, Legislative assemblies of state of union of India, local bodies etc. In direct politics, not only political parties responsible for this situation of women, but also the society is responsible which is not ready to

accept women in politics. The following arguments are made about women being called weak in politics: (a) women candidates have very little chance of winning; (b) women are unable to spend time in their domestic work in comparison; (c) women have less political understanding so even if they win, the women's department is kept confided to an area like the children's department. But this myth also breaks through the past several years. Departments like ministry of external affairs and ministry of defense have been successfully run by women. In the first Lok Sabha ,22 women won out of 489 while in the 17th Lok Sabha, 78 out of 543 women won. That is, it has increased from 4.41 percent to 14.36 percent. It is seen in most of the parties that there is a large number of women participating in the election campaign or in other party functions. But only a small percentage is granted tickets when it comes to the elections. To improve the position of women in politics it is necessary to bring women reservation in politics, a women reservation bill was pending for the last several years in Lok Sabha. Along with this ,there is a shortage of training to prepare women workers as leaders in all the parties. This needs to be taken care of then the situation of women in politics can improve.

GENETIC DIVERSITY IN CHICKPEA (*CICER ARIETINUM* L.)

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Abstract

Chickpea (*Cicer arietinum* L.) is one of the first grain legumes to be domesticated by humans in old world. It is originated in Western Asia from where it spread in to India and other parts of the world. Chickpea is used as dal in split form and whole fried or boiled seeds are also eaten. Green immature chickpea is also used as vegetable and its dry flour is a major ingredient in snacks and sweets in India and Pakistan. Chickpea is a good source of carbohydrates (50.2-68.8%), proteins (18-25%), fats (4.0-9.8%) and essential minerals (Ca, Fe). The experiment was laid out in Randomized Block Design with three replications. Assessment of genetic diversity for ten quantitative characters of chickpea has been worked out by using Mahalanobis's D2 statistics. Twenty genotypes were grouped into five clusters. The mode of distribution of genotypes to various clusters was at random suggesting that there is no relationship between geographical distribution and genetic diversity. On the basis of inter cluster distance, clusters III and IV were identified as more divergent clusters. The hybridization programme has been suggested on the basis of inter cluster divergence and cluster means for the character studied.

ECONOMIC ANALYSIS OF DIFFERENT CROPS IN ZERO BUDGET NATURAL FARMING (ZBNF) IN NORTHERN TRANSITIONAL ZONE OF KARNATAKA (ZONE-8)

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Abstract

Zero Budget Natural Farming (ZBNF) is a set of natural farming methods where the cost of cultivation of crops is effectively less, it believes in natural growth of crops without adding external synthesised fertilizers and pesticides or any chemical elements to cropping land. Keeping these facts in view, a survey is carried out in Northern Transitional Zone of Karnataka (Zone-8) under the Government of Karnataka sponsored project on ZBNF Operational Research Project to know the economics of ZBNF practices in different crops and cropping systems. Ten ZBNF practicing farmers were selected from 4 districts of Agro climatic Zone -8 and information were gathered through structural questionnaire to obtain different components of economic analysis from land preparation to harvesting and further marketing of the produce. The study indicated that, the yield of Green gram, Soybean and Sugarcane in Belagavi district, Groundnut and Green gram in Dharwad, Cotton, Groundnut,

Soybean, Paddy and Maize in Haveri district and Ground nut in Gadag districts were reduced to the extent of 7-27, 3-45, 9-18 and 16 per cent in ZBNF farms than non ZBNF farms. The cost cultivation and production was reduced to the extent of 37-47, 32-44, 33-42, and 41 per cent, and the input or material cost reduced by 60-83, 50-84, 57-86 and 68 percent in different crops at Belagavi, Dharwad, Haveri and Gadag district, respectively. Thereby, the ZBNF farming practices enhance the net returns to the tune of 17-63, 21-33, 60-262 and 38 percent in different crops and cropping systems at Belagavi, Dharwad, Haveri and Gadag district, respectively. According to National Sample Survey Office (NSSO) data, almost 70 per cent of agricultural households spend more than they earn and more than half of all farmers are in debt. All together ZBNF enhanced the profit per rupee of cost when compared to non-ZBNF farms. Natural farming methods reduce farmer's dependence on loans to purchase inputs they cannot afford. Meanwhile, inter-cropping allows for increased returns intermittently. Apart from reduced costs and increased returns (margins) under ZBNF practice, the ZBNF method maintains soil health by promoting soil aeration, minimize water requirement through intercropping, soil and straw mulching and discourages intensive irrigation and deep ploughing. The ZBNF practice is directly help the farmers to gain benefit even under adverse market price fluctuations due to less production cost of their produce.

EFFECT OF ORGANIC AMENDMENTS ON PRODUCTIVITY OF RICE-WHEAT CROPPING SYSTEM AND SOIL PROPERTIES UNDER SODIC SOIL CONDITIONS

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Abstract

A field experiment was conducted during 2016-17 to 2018-19 as a fixed layout in sodic soil at Crop Production Farm Dalipnagar in the jurisdiction of C. S. Azad University of Agriculture and Technology, Kanpur using salt tolerant and high yielding variety of rice CSR-36 and wheat KRL-210 in rice-wheat cropping system. The initial physico-chemical properties of soil were pH 9.10, EC 0.93 dSm^{-1}, ESP 62.2% and organic carbon 2.8 g kg^{-1}. The soil was sandy loam in texture having available N 165.7 kg ha^{-1}, available P_2O_5 17.5 kg ha^{-1} and available K_2O 215.4 kg ha^{-1}. The experiment was laid out under randomize block design with three replications. The experiment consist of seven treatments viz., T_1- 50%GR, T_2- 25%GR + Rice straw @5 t/ha, T_3- 25%GR + GM @5 t/ha , T_4- 25%GR + GM @5 t/ha + Microbial culture, T_5- 25%GR + Poultry manure @3t/ha. T_6- 25%GR + City Waste Manure @5 t/ha and T_7- Control. The results indicated that maximum yield of grain 42.37 q ha^{-1}, straw 50.89 q ha^{-1} and biological 93.26 q ha^{-1} in rice and grain 36.78 q ha^{-1}, straw 44.73 q ha^{-1} and biological 81.51 q ha^{-1} in wheat was received from 25%GR + Poultry manure @3t/ha. and minimum yield of grain 24.48 q ha^{-1}, straw 29.48 q ha^{-1} and biological 53.96 q ha^{-1} in rice and grain 19.59 q ha^{-1}, straw 24.13 q ha^{-1} and biological 43.72 q ha^{-1} in wheat without treated control plot. The increasing trend of grain yield were 73.08, 66.29, 61.32, 59.03, 48.85 and 41.25 percent in rice and 87.74, 79.37, 72.33, 62.22, 59.20 and 52.37 percent in wheat with the application of 25%GR + Poultry manure @3tha^{-1}., 25%GR + GM @5 tha^{-1} + Microbial culture, 25%GR + City Waste Manure @5 tha^{-1}, 25%GR + GM @5 tha^{-1}, 50%GR and 25%GR + Rice straw @5 tha^{-1} over untreated control plot. The same increasing trend of straw and biological yield was recorded also in both rice and wheat crop. The maximum uptake kg $ha^{-1}$of N 37.2, P 10.5 and K 11.7 in grain and N 17.4, P 13.2 and K 78.6 in straw of rice and N 39.4, P 11.7 and K 12.8 in grain and N 18.6, P 14.5 and K 80.2 in straw of wheat with the application of 25%GR + Poultry manure @3tha^{-1}. Followed by 25%GR + GM @5 tha^{-1} + Microbial culture, 25%GR + City Waste Manure @5 tha^{-1}, 25%GR + GM @5 tha^{-1}, 50%GR and 25%GR + Rice straw @5 tha^{-1}. The minimumuptake kg ha^{-1} of N 19.2, P 5.6 and K 6.2 in grain and N 8.6, P 7.5 and K 45.8 in straw of rice and N 21.1, P 6.1 and K 6.8 in grain and N 8.9, P 7.6 and K 38.8 in straw was recorded in untreated control plot.The change was noticed improved in pH 6.7%, EC 7.5%, ESP 22.5%, organic carbon 26.3%, N 7.3%, P 20.8% and K 5.7% with the application of 25%GR + Poultry manure @3tha^{-1} over untreated control plot. The maximum changes in physico-chemical properties of soil with the application of 25%GR + Poultry manure @3tha^{-1} Followed by 25%GR + GM @5 tha^{-1} + Microbial culture, 25%GR + City Waste Manure @5 tha^{-1}, 25%GR + GM @5 tha^{-1}, 50%GR and 25%GR + Rice straw @5 tha^{-1}., wherase not remakable changes in untreated control plot.

ASSOCIATION OF POLYMORPHIC VARIANTS OF CHICKEN GROWTH HORMONE (CGH) 1 GENE WITH GROWTH TRAITS IN POONCHI CHICKEN

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Abstract

For the present study, fifty blood samples were collected randomly from Poonchi chicken located at different altitude of Poonch district along with their growth records i.e., 0, 2, 4, 6, 8 and 10 weeks of age. After the isolation of genomic DNA, PCR amplification of cGH 1 gene was done to obtain 776 bp amplified PCR product. PCR-RFLP was performed by using *MspI* restriction enzymes for genotyping. The resultant digested products were run on 2.5% agarose gel, revealed five types of genotypes for cGH 1 gene: A1A1 (414 bp, 237 bp, 125 bp), A2A2 (267 bp, 237 bp, 147 bp, 125 bp), A1A2 (414 bp, 267 bp, 237 bp, 147 bp, 125 bp), A3A3 (539 bp, 237 bp) and A1A3 (539 bp, 414 bp, 237 bp, 125 bp). The genotype frequencies in Poonchi chicken for cGH 1 gene were found to be 0.32 for A1A1 genotype, 0.08 for A1A2 genotype, 0.08 for A1A3 genotype, 0.16 for A2A2 genotype and 0.36 for A3A3 genotype and the gene frequencies were found to be 0.40 for A1 allele, 0.20 for A2 allele and 0.40 for A3 allele. The highly significant ($P<0.01$) Chi-square value showed that the population was not in Hardy-Weinberg equilibrium (HWE). Least squares analysis of variance among the growth traits for different genotypes of cGH1 gene revealed significant ($P<0.05$) differences at 0 week of age, whereas highly significant ($P<0.01$) differences were found at 2, 4, 6, 8 and 10 weeks of age. Genotype A2A2 had significantly ($P<0.05$) higher body weight at 0, 2, 4, 6, 8 and 10 weeks of age followed by A1A1, A3A3, A1A3 and A1A2 for cGH 1 gene. It can be concluded from the results of present study that the Poonchi chicken of A2A2 genotype for higher body weight could be selected for future breeding for improving growth trait.

CHICKEN GROWTH HORMONE (CGH) 1 GENE POLYMORPHISM IN POONCHI CHICKEN

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Abstract

The present study was carried out on a total of fifty Poonchi chicken with the objectives to determine genetic polymorphism of cGH1. The blood samples were collected from Poonchi chicken randomly and accordingly DNA was isolated by using DNA Kit. The purity of DNA was checked using spectrophotometer by taking the ratio of optical density values at 260nm and 280nm. Only good quality DNA that was having OD values ranging from 1.7 to 1.9 was used for further analysis. A 776 bp segment was amplified by PCR using pair of primers *i.e.*, forward primer with sequence 5'- ATC CC AGG CAA ACA TCC TC-3'and reverse primer with sequence 5'- CCT CGA CAT CCA GCT CAC AT -3' for amplification of cGH1 gene. Genotyping of individuals for cGH1 gene by using *MspI* restriction enzyme was done by PCR-RFLP. Five types of genotypic patterns for cGH 1 gene *viz.*, A1A1 (414 bp, 237 bp, 125bp), A2A2 (267 bp, 237 bp, 147 bp, 125bp), A1A2 (414 bp, 267 bp, 237 bp, 147 bp, 125 bp), A3A3 (539 bp, 237 bp) and A1A3 (539 bp, 414 bp, 237 bp, 125 bp) were obtained. No A2A3 genotype was found. The genotypic frequencies in Poonchi chicken for cGH 1 gene were found to be 0.32 for A1A1 genotype, 0.08 for A1A2 genotype, 0.08 for A1A3 genotype, 0.16 for A2A2 genotype and 0.36 for A3A3 genotype and the gene frequencies were found to be 0.4 for A1 allele, 0.2 for A2 allele and 0.4 for A3 allele. The highly significant ($P<0.01$) Chi-square values for cGH1gene showed that the population was not in Hardy-Weinberg equilibrium (HWE). From the study, it may be concluded that cGH1 gene might be a potential molecular marker for genetic selection in Poonchi Chicken.

CRISPR/CAS9 TECHNOLOGY : EXTENDING BEYOND GENOME EDITING

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Abstract

CRISPR is becoming an indispensable tool in biological research. Once known as the bacterial immune system against invading viruses, the programmable capacity of the Cas9 enzyme is now revolutionizing diverse fields of biotechnology and agriculture. The clustered regularly interspaced short palindromic repeats/CRISPR-associated protein 9 (CRISPR/Cas9) system uses single-guide RNAs for genome editing, making it a simple, robust, powerful tool for targeted gene mutagenesis, knockout and knock-in/replacement, as well as transcriptional regulation. It has a unique property for the introduction of site-specific double-stranded DNA breaks to modify precisely the targeted sequences. The most widely used system is the type II clustered regularly interspaced short palindromic repeat (CRISPR)/Cas9 (CRISPR-associated) system from Streptococcus pyogenes. It is faster, cheaper and more accurate than previous techniques of editing DNA and has a wide range of potential application.

PRECISION NITROGEN MANAGEMENT IN RICE-WHEAT CROPPING SYSTEM FOR HIGHER SUSTAINABLE PRODUCTION IN IGP REGION OF INDIA

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Abstract

The rice-wheat cropping system (RWCS) is a major production system in the Indo-Gangetic Plains of India and covering nearly 10.5 mha including. In India, RW system account for about >80% of the total cereal production and about 50% of the total calorie intake. More than 90% area of the RW area is irrigated and is facing yield stagnation, soil degradation, declining ground water table and air and water pollution due to poor nitrogen management (Singh *et al*., 2011). In our country nitrogen use efficiency is about 20-30%. The human population continues to grow steadily with the shrinking resources being used for agricultural production situates great challenge against Indian agricultural system to attain food and environmental security. To counter these twin challenges in the country there is urgent need of application of modern Hi-tech technologies for enhancing the productivity and sustainability of the rice-wheat system for long term on scientific basis. Precision farming (PF) looks a win technology towards improving the capability of agricultural land to produce crops on sustainable basis. The PF is based on the concept of determination of spatial and temporal variability in the crop production which in turn aimed for increasing crop productivity and reducing environmental menaces. It is innovative technology which comprises the application of several Hi-tech tools like Geographical Information System (GIS), Global Positioning System (GPS), Remote Sensing (RS), Variable Rate Technology (VRT), Decision Support System (DSS), and Farmer. Precision land levelling, precision planting, precision nutrient management by using Green Seeker, leaf colour chart (LCC), site specific nutrient management has a lot of potential for enhancing crop yield and input use efficiency under field conditions while reducing the cost of production and deleterious impacts on environmental. Among different precision nutrient management practices STCR produced significantly higher grain yield by 13.86 and 33.83% over SPAD and control, respectively, but it remained at par with Green seeker and 100% RDF. However, amongst the precision N management practices, STCR resulted significantly higher N, P and K harvest index and agronomic efficiency, apparent recovery and physiological efficiency except nitrogen physiological efficiency in green seeker. In India, there are wide

possibilities to practice a part of PF technologies in rice-wheat system accomplished through the use of simple and inexpensive gadgets like LCCs and expensive gadgets like chlorophyll meter and optical sensors.

COMBINING ABILITY BASED SELECTION IN FOUR POTENTIAL INTRA-HIRSUTUM CROSSES TO ISOLATE TRAIT BASED TRANSGRESSIVE SEGREGANTS IN COTTON (*GOSSYPIUM HIRSUTUM* L.)

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Abstract

Germplasm and the utilitarian diversity it carries in terms of desirable constellation of genes and there by traits serve as a tool to develop potential varieties suitable for different niche commercial cultivation situations. Cotton breeders through their concerted efforts always look towards generating diverse populations for exercising selection. Development of cotton varieties or hybrids having greater yield potential with acceptable fibre characteristics is the main objective of cotton breeder. Seed cotton yield, its components and fibre quality characters of a plant are heritable in nature and thus genetic improvement in all these characters through selection and breeding is possible. The experimental material for the present study was developed by selecting desirable individual plants in the four F_2 populations of potential intra-hirsutum cotton hybrids with stable performances in the multi location trials. 100 individual plant selections made from each of such an F_2 population were carried forward to the F_3 generation. The outcome of present investigation in terms of mean progeny performance of the selected plants revealed desirable transgressive segregants *viz.*, RAH-1831 (167.0 g), RAH-1824 (105 g), RAH-18376 (63 g) and RAH-18386 (67 g) which were on par with the checks BGDS 1063 (104 g) and SCS793 (56 g) for the character seed cotton yield per plant (g). These lines out yielded the checks under study. The top performing lines for UHML (mm) were RAH-18179 (31.5 mm), RAH-1839 (30.2 mm), RAH-18226 (30.5 mm) and RAH-1842 (30.3 mm). The genotypes with higher fibre strength (g/tex) were RAH-18290 (27.3 g/tex), RAH-1875 (26.5 g/tex), RAH-18170 (26.90 g/tex) and RAH-18389 (24.5 g/tex). Further these lines would further be evaluated for developing trait based lines which would serve as parents in furthering the cause of cotton improvement.

TISSUE CULTURE IN CROP IMPROVEMENT

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Abstract

Plant tissue culture comprises a set of in vitro techniques, methods and strategies that are part of the group of technologies called plant biotechnology. Tissue culture has been exploited to create genetic variability from which crop plants can be improved, to improve the state of health of the planted material and to increase the number of desirable germplasms available to the plant breeder. Tissue-culture protocols are available for most crop species, although continued optimization is still required for many crops, especially cereals and woody plants. Tissue culture techniques, in combination with molecular techniques, have been successfully used to incorporate specific traits through gene transfer. In vitro techniques for the culture of protoplasts, anthers, microspores, ovules and embryos have been used to create new genetic variation in the breeding lines, often via haploid production. Cell culture has also produced somaclonal and gametoclonal variants with crop-improvement potential. The culture of single cells and meristems can be effectively used to eradicate pathogens from planting material and thereby dramatically improve the yield of established cultivars. Large-scale micropropagation laboratories are providing millions of plants for the commercial ornamental market and the agricultural, clonally-propagated crop market.

With selected laboratory material typically taking one or two decades to reach the commercial market through plant breeding, this technology can be expected to have an ever increasing impact on crop improvement as we approach the new millenium.

GENETIC ANALYSIS FOR YIELD AND ITS ATTRIBUTES IN GREEN GRAM (*VIGNA RADIATA* L. WILCZEK)

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Abstract

Green gram (*Vigna radiata* L. Wilczek) is one of the most important pulse crops plays a vital role in the health and nutritional security of human beings. It belongs to leguminosae family and diploid chromosome number (2n=22). It is grown in tropic and sub tropic regions of Asia, Africa, Central and Southern America, parts of Southern Europe, USA and India. Its short duration coupled with photo and thermo-insensitive make it easily fit in different cropping system. It has been recognized as a good source of vegetarian protein particularly in the developing countries where majority of the population depends on number of component characters, which are quantitatively inherited. The genetic analysis plays a significant role in crop improvement to generate information on combining ability to understand the type of gene action governing yield and yield contributing traits and to identify superior general and specific combiners which could be exploited for future breeding programme in green gram. Thirty F_1 crosses were developed by Line x Tester mating design involving 10 diverse and homozygous lines and three testers. Ten parents and their 30 F_1's were sown in a randomized complete block design with three replications at Chandra Shekhar Azad university of Agriculture and Technology, Kanpur, U.P., India. The line x tester analysis revealed significant non-additive gene action for almost all the characters. The estimates of specific combining ability variance were much higher than the general combining ability variance. Average degree of dominance indicated over dominance for all the characters. The results showed that it was possible to pick up a good general combiner for all the traits because combining ability effects of parents were not consistent for all the attributes. Genotypes KM2248, KM 2262, KM 2272 and KM 2318 were identified as good general combiner for seed yield per plant, pods per plant, plant height and days to maturity. 14 out of 30 F_1 showed significant positive sca for seed yield. It was observed that desirable cross combinations included high x high and high x medium types of general combiners. The cross KM 2248 x KM 2241, KM 2272 x KM 2241 was the best for pods per plant, 100-seed weight and plant height which resulted in high seed yield of this cross. Other promising cross was KM 2318 x KM 2195 and KM 2272 x KM 2241 for 100-seed weight and seed yield. For all the traits, major portion of the total variance was contributed lines and their interaction with the tester.

EVALUATION OF SOME PHYSICO-CHEMICAL CHARACTERISTICS OF RICE VARIETIES

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Abstract

An experiment was conducted during *kharif* season of 2018-2019 at crop research Farm Nawabganj, Chandra Shekhar Azad University of Agriculture and Technology ,Kanpur for evaluation of some physico-chemical characteristics of 15 rice varieties which were analysed for their Physical and chemical qualities. The varieties taken were DRR-28, DRR-38, NDR-97, CSAR-1610, CSAR-1611, RP-5014, CSAR-1631, DRR-10, Basmati-370, PB-1, Pant-12, CSAR-17135, DRR- 27, DRR-17, Kalanamak. In physical characteristics like moisture content, test weight, Chalkiness, hulling, milling and head rice recovery percentage were studied. The highest moisture content was found in DRR-17 and lowest in PB-1. The highest test weight was found in CSAR- 1631 and lowest in Kalanamak . The highest chalkiness percentage was found in DRR-27 and lowest in DRR-28. The hulling, milling and Head rice recovery percentage is highest in DRR-28 and hulling lowest in Kalanamak, milling lowest

in CSAR-1631 and head rice recovery lowest in PB-1. In chemical characteristics in varieties DRR-28 highest percentage protein content and lowest in CSAR-17135. The protein value ranged from 7.43 to 6.18 % while Amylose content ranged from 17.07 to 24.41%. The highest Amylose value found in Basmati-370 and lowest in DRR-28 and The highest Mineral matter value found in DRR- 28 and lowest in Pant-12.

GENETIC VARIABILITY IN GROUNDNUT GENOTYPES (*ARACHIS HYPOGAEA* L.)

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Abstract

Groundnut (*Arachis hypogaea* L.) is an important food, feed and oilseed crop. It contains 48-50% oil and 26-28% protein, and is a rich source of dietary fiber, minerals, and vitamins. It is grown in nearly 100 countries. Major groundnut producers in the world are: China, India, Nigeria, USA, Indonesia and Sudan. Groundnut is gaining importance as a food crop, on account of high digestible proteins, vitamins, minerals, phytosterols and due to increased consumer preference after value addition. Over 100 countries worldwide grow groundnut. Developing countries constitute 97% of the global area and 94% of the global production of this crop. The production of groundnut is concentrated in Asia and Africa (56% and 40% of the global area and 68% and 25% of the global production, respectively). In India, the area, production and productivity of groundnut during 2018-19 were 48.537 lakh hectares, 69.696 lakh tones and 1436.00 kg/ha, respectively. While in Rajasthan, the area, production and productivity of groundnut during 2018-19 were 6.689 lakh hectares, 16.381 lakh tones and 2449 kg/ha, respectively. There is a need to identify high yielding groundnut genotypes which will be useful and economic to farmers of the area. Hence, keeping in view, the field experiments were conducted at Instructional Farm, CTAE (MPUAT), Udaipur, ARSS, Pratapgarh, ARS, Banswara, KVK, Chittorgarh and ATC, Chittorgarh during *Kharif* 2017 and 2018. Among the tested entries viz., ICGV 07038 (4430 kg/ha), followed by TG 37 A (3270 kg/ha) were found highest dry pod yielder and recorded significantly superior dry pod yield over the checks viz. TG 37 A (3270 kg/ha), TAG 24 (3206 kg/ha), TG 26 (3168 kg/ha), JL 501 (3139 kg/ha), GG 7 (3087 kg/ha) and Pratap Raj Mungphali (2740 kg/ha). Kernel yield of ICGV 07038 (3037 kg/ha) also significantly superior over all the checks viz. TG 37 A (2404 kg/ha), TG 26 (2201 kg/ha), GG 7 (2190 kg/ha), TAG 24 (2155 kg/ha), JL 501 (2079 kg/ha) and Pratap Raj Mungphali (1870 kg/ha). Days to 50 percent flowering ranged from 32-37 days, 100 kernel weight ranged between 39 to 55g, shelling percent ranged from 66-71, days to maturity were ranged between 98 to 105 days, oil percentage ranged from 43 to 51pecent, dry haulm yield ranged from 4265 to 6649 and sound mature kernels were ranged from 87 to 93%. Test entry ICGV 07038 exhibit resistance to collar rot, stem rot and foliar disease resistance and also moderately resistant to major insect pest.

DIRECT AND RESIDUAL EFFECT OF PROM ON PRODUCTIVITY, NUTRIENT UPTAKE, SOIL PROPERTIES AND ECONOMICS UNDER CHICKPEA–PEARL MILLET CROP SEQUENCE IN LOAMY SAND SOIL

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Abstract

A field experiment was conducted at RARI, Durgapura-Jaipur in irrigated coarse textured agro ecological situations during Rabi 2016-17, 2017-18 and Khrif 2017, 2018 to study the effect of organic source of Phosphate fertilizer (PROM) as an alternative and indigenous source of chemical phosphatic fertilizer for sustainable Chickpea and pearl millet production in Chickpea–pearl millet cropping sequence. Eight treatments i.e. 1, 1.5, 2, 2.5, 3 and 3.5 t/ha PROM were applied along with recommended dose of N, K compared with Recommended dose of NPK and control in RBD with three replication. Two year data revealed that all the treatments gave

significantly higher grain and straw yield of chickpea over control (12.08, 9.42 and 21.00, 14.70 q/ha) without NPK. All the other treatments where PROM was applied T_5 *i.e.,* 2.0 t/ha + N K and above gave at par grain and straw yield with recommended dose (18.25, 15.13 and 30.17, 24.12 q/ha) of NPK except treatments T_1, T_3 and T4 *i.e.,* control and where the PROM was applied @ 1, 1.5 t/ha.

EFFECT OF FOLIAR APPLIED ZINC AND BORON ON GROWTH, YIELD AND QUALITY PARAMETER OF WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

A field experiment effect of foliar spray of zinc, boron alone and in combination wheat variety Unnatt PBW-343 during rabi season 2018-19 and experiment was conducted in crop research farm Nawabganj, CSA University of Agriculture and Technology, Kanpur. Total treatment considerate nine with randomized block design and three replication *viz.,* T_1- Zn_1 (0.25%), T_2- Zn_2 (0.50%), T_3- B_1 (0.1%), T_4- B_2 (0.2%), T_5-Zn_1B_1 (0.25% + 0.1%), T_6- Zn_1B_2 (0.25% + 0.2%), T_7- Zn_2B_1 (0.5% + 0.1%), T_8- Zn_2B_2 (0.5% + 0.2%), T_9– Control. The result revealed that application of T_8-Zn_2B_2 (0.5% + 0.2%) produced significantly higher seed yield (50.80q/ha) in comparison to control (48.40q/ha). Likewise plant height (cm), number of branches/plant, days of 50% flowering, ear/plant, biological yield, test weight, seed germination (%), root and shoot length (cm) and dry weight of shoot and root was produced significantly higher in treatment T_8-Zn_2B_2 (0.5%+0.2%) in comparison to control.

IMPACT OF DRUDGERY REDUCING TECHNOLOGIES ON WORK EFFICIENCY AND HEALTH SECURITY OF FARM WOMEN

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Abstract

Women form 50 percent of population and constitute 60 percent work force but earn only 10 percent of income. Women are the backbone of agricultural workforce but worldwide their hard work has been undervalued. They contribute substantially in the physical aspect of farming, live-stock management, post harvest management, home related activities and other allied activities. These tasks not only demand considerable time and energy but also are sources of drudgery for rural women. Added to drudgery women also suffer from different health problems which adversely affect their working efficiency and family welfare. Some of the drudgery reducing technologies such as fuel efficient smokeless chulha, Groundnut stripper, Groundnut decorticator, hand wheel hoe weeder with tynes, lemon harvester and hand gloves for harvesting of bengalgram were conducted as front line demonstrations in six villages of Vijaypur district. The sample size of the study comprised of sixty farmwomen. Percentage increase in efficiency was calculated. The results revealed 44.90 percent of savings in fuel (firewood) by using smokeless chulha as compared to traditional chulha. It emits less smoke and also saves time of cooking. Use of groundnut stripper improves the work efficiency by 12.96 percent and prevents the strain on fingers during stripping of groundnut as compared to manual stripping. Groundnut decorticator improves the work efficiency by 96.16%. It is very useful during sowing season. No pain to the tip of fingers and no body ache. It also saves time and energy. By using lemon harvester 60.24 percent of extra fruits can be plucked .Hand wheel hoe weeder with tynes improves the work efficiency by 31.05 percent. Cloth gloves for harvesting bengalgram increases the work efficiency by 22 percent and moreover it saves labour expenses. It also prevents the formation of boils and cuts on the palms. Thus it can be concluded that the new technologies have positive impact on work efficiency and health security of farm women.

STUDY OF SIEVE SIZE ON THE SEED RECOVERYAND SEED SIZE OF WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

The presented investigation was carried out during 2017-18 in the department of Seed Science and Technology at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.). The experiment was laid out in completely randomized block design with three replication. The prescribed procedure for seed quality assessment was follow during this experimentation. In the present study four varieties of wheat viz. K-607 (V_1), K-1006(V_2), K-307 (V_3), and K-9107 (V_4), were selected. The raw seeds of above varieties were graded with four different sieves having oblong aperture size of 2.50 mm (S_1), 2.30 mm (S_2), 2.20 mm (S_3), and 2.10 mm(S_4). Each grade was assessed for its seed quality parameter in the seed science laboratory. The observation on seed recovery percentage, 1000 seed weight(g), 1000 seed volume (u), 1000 seed density(g/u), first count test, standard germination percentage, seedling. The results, seed recovery percentage was highly influenced by variety sieves size and their interaction maximum seed recovery was observed in variety K-9107 while lowest was seen in K-1006 highest seed recovery was observed at 2.10mm sieves while lowest seed recovery was produced by 2.50mm sieves. Increasing the seed recovery percentage was recorded as the sieve operator size decrease. Highly seed recovery percentage obtained in the treatment combination of V_4S_4maximum seed recovery with standard germination percentage and while lowest was seen V_3S_1decrease seed recovery.

IMPROVING BARLEY PRODUCTIVITY THROUGH DATE OF SOWING AND USE OF ORGANIC MANURES, MULCHING AND CHEMICAL SPRAYS

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Abstract

A field experiment was conducted during *Rabi*, season of 2016-17, 2017-18 and 2018-19 at Crop Research Farm, Nawabganj, CSA University of Agriculture & Technology, Kanpur to find out effect of date of sowing and effect of manures, mulching and chemicals sprays on the productivity of barley. Date of sowing *viz;* 15 Nov. and 15 Dec. in main plot. Fertilizer doses *viz;* T_1-60:30:20 NPK kg/ha, T_2-60:30:20 NPK kg/ha + FYM@ 5.0t/ha, T_3-60:30:20 NPK kg/ha, + Mulching @ 6.0 t/ha, T_4-60:30:20 NPK kg/ha + FYM@ 5.0 t/ha + Mulching @ 6.0 t/ha, T_5-60:30:20 NPK kg/ha + FYM@ 5.0 t /ha + Mulching @ 6.0 t/ha + spray of $ZnSO_4$ @ 0.5% at 80 days after sowing of crop, T_6-60:30:20 NPK kg/ha + FYM @ 5.0 t /ha + spray of KCL @ 0.5% at 80 days after sowing of crop in sub plot were assigned in split plot design with three replications. The variety of barely HUB–113 was used during the period of three year experimentation. Fertilizers were uniformly used in each plot @ 60:30:20 kg Nitrogen, Phosphorus and Potassium per hectare, ½ dose of Nitrogen and full dose of Phosphorus and Potassium were applied as basal and remaining ½ dose of Nitrogen at first irrigation. The FYM @ 5.0 t/ha was applied 15 days before sowing of crop according to treatments. The mulching was used @ 6.0 t/ha according to treatment at one month after sowing of crop. On the basis of three year study it was observed that the maximum grain yield (47.54 q/ha) was recorded in timely sowing on 15 Nov. and late sowing on 15 Dec. (38.42 q/ha). The 23.23% yield increase in 15 Nov. sowing in comparison to sowing of 15 December. Among the fertilizers it was observed that the maximum yield (44.71 q/ha) was recorded under the application of 60:30:20 NPK kg/ha + FYM @ 5.0 t/ha + Mulching @ 6.0 t/ha + KCl @ 0.5% fallowed by with the application of 60:30:20 NPK kg/ha + FYM @ 5.0 t/ha + Mulching @ 6.0t/ha + spray of $ZnSO_4$ @ 0.5% (43.53q/ha). The minimum yield (41.64 q/ha) was recorded under the application of NPK @ 60:30:20 kg/ha. The 7.22% yield increased under the application of 60:30:20 NPK kg/ha + FYM @ 5.0 t/ha + Mulching @ 6.0 t/ha + spray of KCl @ 0.5% over recommended dose of NPK @ 60:30:20 NPK kg/ha.

EFFECT OF OFFSPRING MIGRATION ON PSYCHOLOGICAL WELLBEING OF RURAL ELDERLY

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Abstract

Family is the main source of old-age support for the elderly and adult children are the primary care providers to their aged parents Dispersion of adult children as a result of massive rural-urban migration may undermine the old-age support arrangement and affect the well-being of the elderly. The separation of families due to rural-to-urban migration poses major challenge to elderly care in rural areas as the traditional method of inter-generational elderly support is under considerable pressure with potential implications on older adults' mental health. This paper examines the effect of migration of adult children on the psychological well-being of rural elderly. The study was carried out in Utnal village of Vijayapur district and Dadanatti, Kajjidoni and Sunag tanda of Bagalkot district of Karnataka. The total sample comprised of 102 elderly persons aged 65 years and above whose adult children had migrated to other places other than their place of origin. A standardized scale was used to measure the psychological well-being of rural elderly. The scale consists of five areas namely satisfaction, efficiency, sociability, mental health and interpersonal relations with 10 items in each area. The results revealed that 53.92 percent of the respondents had low level of psychological well being. Only 4.90 percent of them had high level of psychological well being. Psychological well being of the rural elderly was found to be low due to sons' migration in 73.54 percent of the respondents. Income had a positive and significant relationship (+0.203**) with the psychological wellbeing of the elderly. Life satisfaction (+0.185*), Efficiency (+0.135*), Sociability (+0.165*), Mental health (+0.170*) and interpersonal relations (+0.162*) had a positive and significant relationship at 5 percent level with the psychological well being of the rural elderly. Further it was observed that having enough money to meet daily and health needs, childrens' regular visit and financial support each contributed to the psychological well being of elderly.

MOTHBEAN : A WONDER CROP OF ARID LEGUME

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Abstract

Mothbean (*Vigna acontifolia*) is a native crop of hot and dry habitats of northern and western parts of India. These very adjusting abilities have rendered this crop as an indispensable component of the cropping system prevailing in arid regions. This crop is used as a source of food, feed, fodder, green manuring and green pasture. Green pods are a delicious source of vegetables. Being a pulse, it is a cheap source of vegetable protein for balancing nutritional deficiency. A total of 9.26 lakh hectares and 2.77 lakh tonnes of mothbean production was recorded in the country during the twelfth plan (2012-15) period. Area and production of mothbean have been highest in Rajasthan (96.75% and 94.49%) followed by Gujarat (2.38% and 3.6%). However, the productivity of Rajasthan (292 kg/ha) was below the national average productivity (299 kg/ha). Major mothbean growing districts of Rajasthan are Churu, Bikaner, Barmer, Nagaur, Jodhpur, Hanumangarh and Jalore. It can tolerate high temperatures without any adverse effect on flowering and fruit development. Optimum temperature requirement for growth and development is 25-37°c. The bulk of the cultivation is, confined to dry-lands of the arid zone with a 250-500 mm rainfall requirement with the arrangement of proper drainage. It can survive for almost 50 days without rains in concomitant atmospheric temperature peaking to 400C from the emergence of the seedlings onwards. Mothbean is an essential dietary component in the Indian arid zone. It is the potential reservoir of protein (22-24%), essential minerals and vitamins. It is the cheapest source of protein and providing nutritional security to vegetarians in the arid zone. It is consumed in the form of *Dal* (Mogar), sprouts and green pods as a vegetable. It is the principal ingredient of a famous spicy snack *Bikaneri Bhujiya*. It is also consumed in the preparation of other food products like *Papad, Namkeen, Mangori, Dal vada* etc. About 80 per cent of the mothbean production of

Rajasthan is consumed in agri-industries at Bikaner. There are some important varieties which recommended for the arid zone of Rajasthan are namely; RMO-257, RMO-435, RMO-2004 (RMB 25), RMO-225, RMO-40, FMM -96, Moth 880, Jadiya, Jwala, CAZRI Moth-2 (CZM 45), CAZRI Moth-3 (CZM 99) and TMV(Mb-1).

FIRST PRINCIPLE INVESTIGATIONS ON STRUCTURAL, ELECTRONIC AND THERMODYNAMIC PROPERTIES OF THALLIUM NEODYMIUM DISULFIDE (TLNDS2)

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Abstract

DFT analysis of structural, spin polarized electronic and thermodynamic properties of Thallium neodymium disulfide ($TlNdS_2$) have been carried out using full-potential linearized augmented plane-wave plus local orbital method. The lattice parameters (a_0), bulk modulus (B_0) and its first order pressure derivative (B'_0) have been calculated for $TlNdS_2$. Structural and spin polarized electronic properties have been calculated by WIEN2K software. We studied spin polarized electronic properties in terms of band structure and density of states plots for spin-up and spin-down channel. The Quasiharmonic Debye model has been used successfully to calculate the temperature dependent thermodynamic properties. Thermodynamic properties have been obtained by GIBBS 2 software. Thermodynamic properties have been investigated in terms of temperature variations of volume(V), bulk modulus(B), Debye temperature(θ_D), Grunesien parameter (γ), specific heat (C_v) and thermal expansion coefficient(α) for $TlNdS_2$. The calculated thermodynamic properties are found to be in good agreement with available experimental/theoretical literature values.

SUSTAINING SOIL HEALTH THROUGH ORGANIC FARMING

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Abstract

Soil is a dynamic entity at the atmosphere-lithosphere interphase containing flora and fauna to nurture the life on earth. Soil health is dependent on a combination of biological, chemical and physical properties. Healthy soils are essential for resilient crop production, with positive contributions to soil water retention which improve crop performance in times of drought and supporting a diversity of organisms vital to decomposition and nutrient cycling. Conventional farming practices actively deplete soil quality which can be enhanced by incorporating cover crops, animal manure and/ or compost in to the soil, all of which increase the amount of oil organic carbon (SOC). SOC is a key component of heslthy soils with positive impact on physical, chemical and biological soil properties. It provides structural stability to the soil, reduces erosion, protects against soil compaction, and improves aeration, water infiltration and water holding capacity. However, the SOC content in most cultivated soils of India is less than 5 g/kg soil compared with 15 to 20 g/kg soil in uncultivated virgin soils. Sustained soil health can be achieved by moving back to the era of natural farming or organic way of agriculture. Current organic agriculture performs well in several sustainability domains, like animal welfare, farm profitability and low pesticide use, but yields are commonly lower than in conventional farming. Recent data analyses with global coverage show that organic crop yields are on average of conventional yields. In the last 15 years, organic agriculture has grown rapidly and today it is being practiced in 178 countries of the world on 97.7 million hectares area constituting 1.2 % of the global agriculture land while in India is only 5.7 million hectare. Global organic food market at $ 89.7 billion and is projected to grow at a CAGR of 16.15%, in value terms, during 2017–2022, to reach $ 262.85 billion by 2022. Organic agriculture is one holistic approach for improving the sustainability of food systems. It refrains from using synthetic fertilizers and pesticides while organic farming discussion starts with the question that how to meet the nutrient requirement of crops through organic manures to maintain crop and soil

health for achieving high production potential. Organic matter content, microbial activity and general soil health are taken as measures of soil fertility. Through organic farming, provision of good quality food is possible without affecting soil health and environment on sustainable basis. There is need for the standardization of suitable organic source for the specific crop and hunting good market for earning good profit from the produce. Management of soil health is challenge for maintaining crop and cropping system productivity under organic production systems. Also, continuous raising of the crops organically has good potential to sequester the carbon in the soil, thereby promoting the turnover of applied organic nutrients which in turn sustains productivity, improves fertility and promotes climate resilient organic farming which in turn can open new avenues for ecological and economic sustainability. Thus, maintaining soil health is essential to human health, ecosystem functions and nature conservancy. So that soil health is more pertinent as global issue now than ever before for advancing food and nutritional security in sustained way.

EFFECT OF SUBSURFACE DRIP IRRIGATION ON SOIL PHYSICAL-CHEMICAL PROPERTIES, GROWTH AND YIELD OF SALT TOLERANT SUGARCANE IN SALINE VERTISOLS OF TUNGABHADRA PROJECT COMMAND

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Abstract

On farm experiment was conducted during 2014-15 to 2017-18 at Agricultural Research Station, Gangavathi to know the effect of subsurface drip irrigation on soil properties, growth and yield of salt tolerant sugarcane (*Saccharum officinarum)* in saline vertisols of Tungabhadra command area. The experiment was laid out in saline soils (4-6 dS m^{-1}) with irrigation methods *viz.*, surface drip, subsurface drip and furrow irrigation (conventional) as main treatments and with irrigation levels *viz.*, 0.8, 1.0 and 1.2 evapotranspiration (ET) as sub treatments. A salt tolerant sugarcane variety Co-91010 was planted in paired row system (0.6x1.20x0.6 m). The pooled data of four years results revealed that more soil moisture was retained in surface drip irrigation method compared to subsurface drip irrigation at 0-15 cm soil whereas in subsurface soil (15-30, 30-45 and 45-60 cm) more moisture was retained in subsurface drip compared to surface drip irrigation method due less evaporation. The higher soil moisture content was observed in Y-direction (along drip lateral) compared to X-direction (perpendicular to drip lateral) because of strip wetting. In case of vertical (Z-direction) soil profiles, soil moisture retained was less compared to lateral directions (X and Y direction) in both the methods of drip irrigation. Significantly higher cane weight was recorded in subsurface drip (1495 g) compared to furrow irrigation (1248 g) among irrigation methods and significantly higher weight was recorded at 1.2 ET (1425 g) compared to 0.8 ET (1319 g) in irrigation levels. Among irrigation methods, significantly higher cane yield (131.0 t ha^{-1}) was recorded in subsurface drip compared to surface drip (124.4 t ha^{-1}) and furrow irrigation (105.0 t ha^{-1}) methods. Among irrigation levels, significantly higher yield (124.7 t ha^{-1}) was recorded at 1.2 ET irrigation level followed by 1.0 ET (121.0 t ha^{-1}) and least in case of 0.8 ET (114.7 t ha^{-1}). Significantly higher water use efficiency (WUE) of 83.0 kg ha^{-1} mm^{-1} was recorded in subsurface drip irrigation compared to surface drip (78.6 kg ha^{-1} mm^{-1}) and furrow irrigation (66.4 kg ha^{-1} mm^{-1}) methods. Among irrigation levels, significantly higher WUE (83.2 kg ha^{-1} mm^{-1}) was recorded at 0.8 ET followed by 1.0 ET (75.9 kg ha^{-1} mm^{-1}) and least in case of 1.2 ET (68.9 kg ha^{-1} mm^{-1}). The brix percentage did not affect by different irrigation methods and irrigation levels and interaction between irrigation methods and levels was found non-significant. Normally the brix percentage was ranging 20.1 to 20.7 in all the treatments. In case of irrigation methods, significantly higher sugar-water use efficiency (S-WUE) was recorded in subsurface drip irrigation (1.72 kg m^{-3}) followed by surface drip irrigation (1.59 kg m^{-3}) and least in furrow irrigation (1.34 kg m^{-3}) method. Among irrigation levels, significantly higher S-WUE was recorded at 0.8 ET (1.66 kg m^{-3}) followed by 1.0 ET (1.57 kg m^{-3})

and least in case of 1.2 ET (1.43 kg m^{-3}) irrigation level. Higher net returns and B:C ratio were recorded in subsurface drip with 1.2 ET irrigation level treatment compare to furrow method with 0.8 ET.

ANALYSIS ON INFLUENCE OF SOCIO-ECONOMIC STATUS AND SELECTED ANTHROPOMETRIC VARIABLES ON THE ATHLETIC PERFORMANCE OF UAS RAICHUR INTER-COLLEGIATE ATHLETES

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Abstract

In sport, the characteristics of Physical, Physiological, Psychological, Sociological and Anthropometrical are functionally associated with the performance of a player or an athlete. Considering the requirements of these characteristics in sport, each sport has its own entity since they differed from one another in nature. Meanwhile, though a particular sport has been defined in the requirements of these characteristics, within variance in spot may arise because of variations exist among the players of particular sport in terms of physical, sociological and anthropometric aspects. The main purpose of the study is to compare the selected anthropometric measurements and socio-economic status among University of Agricultural Sciences, Raichur inter-collegiate athletes. Further, to find out the relationship of anthropometric measurements and socio-economic status in relation to their performance among UAS, Raichur campus inter-collegiate athletes respectively. To achieve the purpose of the study total 36 inter-collegiate athletes in the age group of 18 to 25 years studying in UG Colleges affiliated to University of Agricultural Sciences, Raichur Karnataka, India were selected as subjects by random sampling method. The results of the study found that there is a significant difference between in calf and thigh circumference, arm length and leg length among UAS, Raichur, College of Agriculture, Bheemarayanagudi and College of Agriculture, Kalaburagi athletes. Further, there is a significant influence of socio economic status and anthropometric variables on the UAS, Raichur, athletes in the performance of 100 mtrs event.

EFFECT OF DIFFERENT IRRIGATION METHODS AND SALINE WATER ON SOIL PROPERTIES AND GROWTH OF TOMATO (*SOLANUM LYCOPERSICUM*) CROP UNDER VERTISOLS OF TUNGABHADRA PROJECT COMMAND

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Abstract

The experiment was conducted at Agricultural Research station, Gangavathi (Karnataka) during 2018-19 and 2019-20 to study the effect of three (Furrow-M_0, Surface drip-M_1 and Subsurface drip-M_2) different irrigation techniques and five (0.65 dS m^{-1}-S_0 normal water, 2 dS m^{-1}-S_1, 3 dS m^{-1}-S_2, 4 dS m^{-1}-S_3 and 5 dS m^{-1}-S_4) different irrigation water salinity levels on soil properties viz., soil pH and soil salinity in tomato (*Solanum lycopersicum*) crop under Vertisols of Tungabhadra Project Command. The soil pH was maximum at the top surface during after harvest in first year and decreased in second year during before sowing under all the treatments. In subsurface drip technique the pH at the 15-30 cm was less as compared to 0-15 cm because of buried drip laterals to a depth of 20 cm. In case of surface drip the top surface (0-15 cm) was having slightly less pH as compared to (15-30 cm) after harvest because of frequent application of water at the top surface through drippers. In case of surface drip, more salt were present at 20 cm distance apart from the dripper at 0-15 and 15-30 cm depths. In case of subsurface drip

irrigation, accumulation of salts was more at the soil surface but it was lesser at near and below the buried dripper but increased with distance from the dripper. Due to upward capillary action, more salts accumulated on the top surfaces and at periphery of the water front outside the root zone and less at the root zone of the crop because of continuous salt leaching downwards under subsurface drip. More salt accumulation was observed as salinity level increases. The soil salinity for tomato crop in the active root zone varies within a narrow range. Hence, the salinity was not much affected to the plant roots (20 cm depth). Therefore subsurface drip irrigation can be preferred over furrow irrigation whenever saline water is used under drip irrigation upto a threshold limit of 2 dS m^{-1}. The maximum number of plants per treatments, plant height and number of branches per plant during 30, 60, 90 and 120 days after transplanting (DAT) were recorded higher under subsurface and surface drip as compared to furrow irrigation except plant height during 30 DAT. Similarly, under different irrigation saline water levels, maximum number of plants, plant height and branches were recorded under 0.65 dS m^{-1} and 2 dS m^{-1} treatment and least was recorded in 5 dS m^{-1} treatment. From the study it was concluded that the growth of tomato was good under subsurface drip and surface drip as compared to furrow irrigation under main treatments and under sub treatments, 0.65 and 2 dS m^{-1} treatments performed better as compared to higher salinity levels. Whenever there is shortage of fresh water, saline water upto 2 dS m^{-1} can be used to grow tomato without much effect on the crop growth.

VIBRATIONAL (FT-IR AND FT-RAMAN) SPECTROSCOPIC ANALYSIS OF 5-(2-BROMO-PHENYL)-1H-TETRAZOLE BY DENSITY FUNCTION THEORY

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Abstract

The FT-IR and FT- Raman vibrational spectra of 5- (2- Bromophenyl) -1H- tetrazole have been recorded in the region 4000-400 cm^{-1} and 3500-100 cm^{-1} respectively. Quantum chemical calculations of energies, geometrical structure and vibrational wave number of 5- (2- Bromophenyl) -1H- tetrazole were carried out by density function theory (DFT/B3LYP) method with 6311++ G(d,p) basis set. The computed value of frequencies were scaled with suitable scaling factor and found to be in agreement with experimental values. The vibrational assignments are performed on the basis of total energy distribution of the scaled vibrational modes. Finally experimental vibrational data were compared with the theoretical data. The differences between the observed and scaled wave number values of most of the fundamentals were very small.

PRESENT STATUS AND FUTURE FROSPECTS OF MARKER ASSISTED SELECTION (MAS) IN CROP IMPROVEMENT

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Abstract

Easily identifiable traits are referred to as markers. Markers are used as signpost to find out the variation among the individuals. They are linked to the trait of interest and are co-inherited along with the trait. These can be divided in to morphological markers (Qualitative traits), biochemical markers (variation in isozymes and protein structure) and molecular markers (variation in DNA fragments). Molecular marker/DNA markers/genetic markers is a unique sequence of nucleotides found on a DNA strand. They are located close to gene of interest also called "gene tags." DNA markers those are tightly linked to target loci as a substitute for or to assist phenotypic screening. Ideal DNA marker must be polymorphic, co-dominate in nature, evenly and frequently distributed throughout the genome, high exchange of data between laboratories, absence of non-allelic interaction of epitasis, reproducible and it should be easy, fast and cheap to detect. The utility of a marker depend on how tightly it is

linked to genes controlling important traits. The relative importance of those genes in determing the phenotypes the consistency of linkage disequibrium between the marker and QTL. Marker Assisted Selection (MAS) often used as a synonym of SMART breeding, which stand for selection with markers and advanced reproductive technologies. It is fast-tracking plant breeding. Selection can be made on the genotype rather than phenotype, which may increase the speed and efficiency of selection. MAS was first reported by Tanksley and Rick (1980) used isozyme marker to speed up introgression of a monogenic trait in to adapted tomato cultivars. DNA markers allow the breeder to introduce the gene(s) of interest into their cultivated species from a related species. While conventional breeding methods rely on the transfer of the whole genome (undesirable traits also co-inherited). MAS used in difficult traits e.g. biotic and a biotic stresses) with low heritability (Yield) pyramiding of resistance genes (recessive genes), selection at seedling stage and distinguish homo and heterozygote. Molecular marker allow working with genotype information directly, analyze the effect of genotype on the phenotype and provide breeder a tool to look in to the "black box" of the genotype. Marker Assisted Backcrossing (MAB) has several advantages over conventional backcrossing that is effective selection of target loci, minimize linkage drag and accelerated recovery of recurrent parent. Marker Assisted Backcrossing (MAB) the 1st level of selection/ foreground selection. (Tanksely, 1983). MAB 2nd level of selection (recombinant selection) perpose to reduce the size of the donor chromosome segment that is linked with the gene of interest. MAB 3rd level of selection (Background selection) use unlinked marker to select against donor genome, accelerates the recovery of the recurrent parents genome. Saving of 2,3, or even 4 backcross generations may be possible. Marker Assisted Pyramiding is the process of combining several genes together into a single genotype. MAS can be used as a tool in the crop improvement programme. It can speed up the process of breeding programmes. It can cut short the time required for development of new varieties. MAS is useful in [transferring] disease and insect resistance, male sterility, photoperiod insensitivity and gene pyramiding etc. MAS has been used for genetic improvement of different field crops such as maize, barley, rice wheat sorghum, soybean, chickpea, pea, sunflower, tomato, forage crop and some fruit crops. In rice two bacterial blight resistant cultivars, *viz.*, Angke and Konde have been released through MAS in Indonesia. In addition blast resistant genotypes have been developed. In maize, quality protein maize (QPM) line have been developed through MAS. In soybean line resistant to soybean cyst nematode (SCN) have been developed through MAS.

EFFECT OF LONGTERM CONSERVATION AGRICULTURAL PRACTICES AND REDUCED NUTRIENT DOSES ON RAINFED PIGEONPEA

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Abstract

Conservation agriculture (CA) aims to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water and biological resources combined with external inputs. It contributes to environmental conservation as well as to enhanced and sustained agricultural production. Energy use efficiency in crop production is need of the hour. So the experiment was conducted in rainfed ecosystem. Experiment detail includes permanent main plot treatments (Tillage practice) of flat and raised bed systems with or without residue retention and in sub plots with reduction in recommended doses of fertilizer with three replications on rainfed pigeonpea. Zero till raised bed with residues retention recorded significantly higher plant growth and yield parameters compared to all treatments. In treatment interactions higher SPAD, sustainable yield index and yield parameters were recorded when 100 per cent recommended dose of inorganic fertilizer applied on zero tilled raised bed with residue retention. Zero till-raised bed with residues retention along with 100 percent recommended dose of inorganic fertilizer gave significantly higher pigeonpea seed yield and stalk yield than other combinations. Zero tillage raised bed with residue retention along with zero inorganic fertilizer incurred

lower input energy, but higher net energy, energy use efficiency and B: C ratio compared to all other treatment combinations. Significantly higher seed output energy, sustainable yield index and net returns were observed in 100 per cent inorganic fertilizer in zero tillage raised bed with residue retention compared to other combinations. Finally, looking to energy and economics 50 per cent of recommended dose of inorganic fertilizer can be saved in conservation agriculture practices of zero tillage raised bed with residue retention on a permanent site in rainfed pigeonpea.

EFFECT OF DIFFERENT COMBINATIONS OF UREA TREATED SUGARCANE TOP SILAGE ON ITS OXALATE CONTENT AND BLOOD MINERAL PROFILE IN MURRAH BUFFALOES

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Abstract

The present experimental study was undertaken in eighteen Murrah buffaloes for a period of thirteen weeks. The selected Murrah buffaloes were allotted randomly into three groups, with six animals in each group. The control group (T_0) was maintained without replacement of green maize by sugarcane top silage (SCT), while in treatment groups the green Maize fodder was replaced with sugarcane top silage on DMB @ 50 and 75 %, for T_1 and T_2 groups, respectively. The experimental buffaloes were offered pelleted concentrate feed and jowar kadbi (jowar dry fodder) as routine practice of farm. The Untreated Sugarcane top (UCT) and treated sugarcane top silage (TCT) samples were evaluated for its oxalate content. The oxalate content was observed higher (0.27%) in fresh sugarcane top and lower (0.19%) in sugarcane top silage. Therefore, we can state that, the oxalate content of SCT was reduced by ensiling with 1 per cent of urea on dry matter basis. The blood collection of each experimental animal was done monthly and estimation of blood mineral profiling was carried out by following the standard procedures. Feeding of sugarcane tops silage (SCT) by replacing of the green Maize at 50 and 75 % level did not significantly affect the concentration of minerals in blood. Therefore, it is concluded that we can reduce the oxalate content of SCT by ensiling without any adverse effect on blood mineral profile of Murrah buffaloes.

GROWTH PERFORMANCE AND BIOMETRY OF DECCANI LAMBS FED DIFFERENT LEVELS OF MORINGA LEAF MEAL DIETS

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Abstract

Eighteen growing lambs aged between 4 to 8 months with average weight of 14.19± 1.5 kg were used to evaluate the effect of feeding Moringa oleifera on feed intake, weight gain and feed conversion ratio comprising of three experimental diets viz., 100 percent groundnut cake (T_1), 75% groundnut cake+ 25% *Moringa oliefera* leaf meal (T_2) and 50% groundnut cake+ 50% *M. oliefera* leaf meal (T_3) as protein source in the concentrate mixture with *ad libitum* green fodder. The lambs were randomly assigned to three dietary treatments with six lambs per treatment in a completely randomized design (CRD). The study revealed that, the overall mean body weight of Deccani lambs in T_1 (MLM0%), T_2 (MLM25%) and T_3 (MLM50%) were 17.68 ±1.03, 18.65±1.25 and 18.45±1.20, respectively. Total gain in body weight (kg) was 7.7 ±0.26, 9.13 ±0.24 and 8.67 ±0.25 in lambs fed with T_1 (MLM0%), T_2 (MLM25%) and T_3 (MLM50%) diets, respectively and the difference between diets was significant ($P<0.01$). The average daily gain was significantly ($P<0.01$) higher in lambs fed with T_2 (MLM 25%). The daily average dry matter intake (DMI) per 100 kg body weight was comparatively higher in lambs fed with T_2 and T_3 diets. In intensive farming system, the fortnightly biometric measurement indicated that the mean fortnight body length, face length and hip width of

growing Deccani lambs increased linearly throughout the experimental period and had significance difference ($P<0.05$) among the treatments. However, the height at wither, chest girth and tail length showed non-significance difference among the groups. A similar trend was observed in growing Deccani lambs under semi-intensive system. It was concluded that, diets containing MLM 25% supported better growth performance signifying that inclusion of MLM in lambs reduced feed intake, improved weight gain and feed conversion ratio.

MATHS AS INTERDISCIPLINARY BRANCH OF ENVIRONMENT

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Abstract

Mathematics were created to better understand the rules which govern all things, including nature and the environment. Mathematics problems involving basic computations, percents, ratios, tables, circle charts and graphs are used to illustrate environmental issues such as population growth, wastefulness, resource scarcity and pollution. A lot of calculus-based statistics almost perfectly represent a lot of nature's fundamental behaviour in life, and simple systems of differential equations can describe the movement of a celestial body for its entire life within a galaxy. For instance, from an industrial perspective: Nowadays, a growing number of customers have the preference to obtain products that are ecofriendly. When a bunch of choices are served on the table, how do one decide? This is where maths come in, i.e., method of footprinting, by assessing and quantifying the product. Mathematics weren't something that was there before us, we built it to better see the structures of the universe, like building a telescope to see intimate details of the shore without ever disembarking.

EFFECT OF LINEAR STABILITY ANALYSIS IN AN ANISOTROPIC POROUS MEDIUM

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Abstract

The paper examines, within the framework of linear stability analysis with the model suggested by Brinkman, the thermal instability of an incompressible viscous fluid in the presence of magnetic field confined in an anisotropic porous medium. Uniform temperature and concentration gradients are maintained along z-axis. The interesting properties associated with magnetic field have attracted a number of different results on stability by using perturbations and normal mode analysis. Under different physical situations of the thermal diffusivity and solute diffusivity various results are explained. In present paper, the important results obtained include different conditions of stability, existence of oscillatory modes, non-oscillatory modes, discussion for stable and unstable modes, if exist in the problem.

DEVELOPMENT AND EVALUATION OF HONEYCOMB PACKAGING MATERIAL FOR ENHANCING SHELF-LIFE OF FIG FRUITS (*FICUS CARICA* L.)

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Abstract

Honeycomb packaging material was designed and developed for fresh figs (*Ficus carica* L.) using craft paper based on the average of maximum diameter of the fruits. Freshly harvested fig fruits of commercial maturity and free from bruises/injury were packed in CFB box with news paper lining (Control), CFB box with single layer of fruits and CFB box with honeycomb packaging material lining. The packed fruits were transported to a distance of 300 km by road. The quality parameters *viz*., physiological loss in weight, firmness, per cent damage fruits and decay loss were analysed after transportation and during storage. The results showed that the percent damage (bruised

and peeled) was significantly varied with different packaging materials. The fruit damage was found to be highest in case of CFB box with paper lining (12.2%) followed by CFB box with single layer packing (4.5%) and the lowest of 2.8% was observed in CFB box with honeycomb packaging material. Similarly, the higher firmness, lesser decay loss and less increase in TSS were found in case of fruits packed in honeycomb packaging material compared to other treatments during storage. The study revealed that the honeycomb packaging material could be adopted by the farmers and traders for reducing the transportation damage and for enhancing the shelf life of fig fruits.

STUDY OF WOMAN SELF-HELP GROUPS IN DISTRICT-BARABANKI, MANAGEMENT OF ECONOMIC ACTIVITY IN UTTAR PRADESH

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Abstract

The self help group members must start some economic activities for additional income to sustain financial strength the group. A study was carried out to analyze the process of management of income generating activities in groups. Data were collected both at group and at members' level through analysis of groups' records, through purposely-developed interview schedules and focused group discussion. The study revealed that about 39 per cent members had either started new economic activities or expanded ongoing economic affairs after joining the groups. Average monthly income obtained from new activities was Rs. 5600, while that from expansion of ongoing activities was Rs. 5857. About 65% respondents started economic activities related to agriculture and allied sector. Around 58% of group members, who started new activity, did this group, fulfilling all the requirements of economic activity *i.e* from arrangements of raw materials to marketing of final product. About 85% respondents, who faced financial problems in running the activity, relied on group savings for taking loans; Scientist of Acharya Narendra Dev University of Agriculture & Technology Kumarganj Ayodhya / Krishi Vigyan Kendra Haidergarh Barabanki, solved their technical problems. The members used variety of methods for selling the products.

SITE SPECIFIC NUTRIENT MANAGEMENT (SSNM) FOR TARGETED YIELD IN BT COTTON (*GOSSYPIUM HIRSUTUM*)

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Abstract

Performance of three yield targets (M_{1-3}:3, 4 and 5 t ha^{-1}) and four nutrient practices (S_1- Vermicompost @ 2.5 tha^{-1} in seed line, S_2- S_1+$MgSO_4$ 10 $kgha^{-1}$ in seed line, S_3- S_1+$MgSO_4$ 25 $kgha^{-1}$ in seed line, S_4- $MgSO_4$ 25 kg ha^{-1} in seed line + foliar nutrition of 1%, and control-RDF with recommended practice $MgSO_4$ +19:19:19 + 1% KNO_3 (thrice each)) was assessed using a Spilt plot design during *kharif* 2014-15 and 2015-16 at College of Agriculture Farm, Raichur on medium black soil. SSNM for yield targets of 5 t ha^{-1} and supplementary nutrition of $MgSO_4$ both to soil and to foliage and foliar application of major nutrients (19:19:19 and KNO_3) recorded significantly higher plant height (158 cm), count of monopodials (3.0) sympodials (27.5), nodes on main stem (37.8) at final picking, good opened bolls (61.1 to 61.9), total developed bolls (66.2 - 66.9), lower leaf anthocyanin (0.048 at 135 DAS, respectively on pooled basis), lower LRI indices (1.10 at 135 DAS, respectively), higher productivity efficiency (0.52 during first year), seed cotton yield (5349 kg ha^{-1}) and net returns (Rs.2,45,120/-) over other yield targets and recommended practices.

EVALUATION OF NORMAL AND SALINE IRRIGATION WATER ON SOIL CHEMICAL PROPERTIES OF DISTRICT KANNAUJ, UTTAR PRADESH

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Abstract

The field experiment was conducted during the year 2016 and 2017 at village Jasaura district Kannauj, Uttar Pradesh. Soil samples were collected from 0 -15, 15 – 30 and 30 – 45 cm depth from the field by soil augur. The result was carried out the mean values of pH, (g moles L^{-1}), electrical conductivity (EC) dSm^{-1},carbonate (CO_3^{2-}), bicarbonate (HCO_3), chloride (Cl_2), varied from 7.53 – 7.93, 1.08 – 1.38, 00 – 0.0, 1.23 – 1.70, 1.70 – 2.13, $meql^{-1}$ in pre-sowing maize field whereas; lowest and highest values of above constituents were found (T_1 7.53 – T_2 7.87) and (T_1 7.57 – T_2 7.93), (T_1 1.08 – T_2 1.28) and (T_1 1.08 – T_2 1.38), (T_1 00 – T_2 00) and (T_1 nil – T_2 nil) (T_1 nil – T_2 0.50), (T_1 1.23– T_2 1.57) and (T_1 1.30 – T_2 1.70), (T_1 1.70 – T_2 1.93) and (T_1 1.70 – T_2 2.13) in post harvest maize field respectively.

IMPACT OF NORMAL AND SALINE IRRIGATION WATER ON CHEMICAL PROPERTIES OF SOIL IN DISTRICT KANNAUJ, UTTAR PRADESH

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Abstract

The field experiment was conducted during the year 2016 and 2017 at village Jasaura district Kannauj, Uttar Pradesh. Soil samples were collected from 0 -15, 15 – 30 and 30 – 45 cm depth from the field by soil augur. The result was carried out the mean values of sulphate (SO_4^{2-}), nitrate-nitrogen (NO_3-N), boron varied from 0.77 – 0.98, 0.30 – 0.63 and 0.19 – 0.23 $meql^{-1}$ whatever; lowest and highest values of above constituents were found in treatments T_1 and T_2 previous to final year respectively.

STUDY OF GENETIC VARIABILITY PARAMETERS FOR SEED YIELD AND ITS COMPONENT TRAITS IN MUNGBEAN GERMPLASM UNDER ARID ENVIRONMENT

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Abstract

A field experiment was conducted to study the genetic variability parameters for seed yield and its component traits in mungbean at Swami Keshwanand Rajasthan Agricultural University, Bikaner during *Kharif*-2017. Significant differences were observed among genotypes for all 11 characters studied. The high degree of genetic variability along with high heritability and high genetic advance as per cent of mean were recorded for seed yield per plant, number of pods per plant, harvest index, biological yield per plant and plant height; which indicates that these characters were under the control of additive gene action and therefore, form the basis of selection for mungbean improvement programme. Genotypes/ varieties exhibited higher seed yield along with other desirable traits were Ganga-1, MUM-2, COGG-912, Keshwanand Mung-1, RMG-268, GM-4, SML-668, RMG-492, Samrat, MH 2-15, MH-421, ML-683, IPM 205-7, GAM-5, SML-832, RMG-344, IPM 99-125, IC-39409, Keshwanand Mung-2, Ganga-8, RMG-62, IPM 02-14 and IC-39288. Besides quantitative traits, all these genotypes were also found early

in flowering and maturity, which are considered as the most desirable traits for crop cultivation in an arid environment.

EFFECTS OF COMBINING ABILITY AND GENE ACTION FOR YIELD AND ITS CONTRIBUTING TRAITS IN BREAD WHEAT (*TRITICUM AESTIVUM* L.) UNDER TIMELY SOWN IRRIGATED CONDITION USING LINE X TESTER ANALYSIS

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Abstract

The present investigation entitled "Effects of Combining Ability and Gene Action for Yield and Its Contributing Traits in Bread Wheat (*Triticum aestivum* L.) under timely sown irrigated condition using Line X Tester analysis" was carried out during *Rabi* 2015-16 and 2016-17 at the All India Co-ordinated Wheat & Barley improvement project, B.T.C. College of Agriculture and Research Station, Bilaspur (C.G.). The experiment was conducted in RBD involving ten lines, four testers and 40 F_1s hybrids of wheat with two replications. Analysis of variance for combining ability revealated that mean square due to females were highly significant for all the character. Where for male . It was highly significant for all the character except for number of grains per spike. A perusal of variance ratio suggested the preponderance of non- additive genetic variance for all the character except harvest index. Based on estimates of GCA effect parents *viz.,* MP 1202, Chhattisgarh genhu 03 and HW 2045 were found good general combiner for yield and must of its contributing traits, therefor, were noted as good sorce of favourable genes for increasing yield through various contributing characters. The estimation of SCA effects reveated that none of the hybrid was consistently significantly superior for all the traits. Out of 40 hybrids evaluated, 13 hybrids resistered significantly positive SCA for grain yiels per plant. The highest non additive gene action for seed yield per plant, harvest index, 1000 seed weight and spike length are found in crosses of MP 1202 X GW 2013-507.

IMPACT OF FRONT LINE DEMONSTRATION ON THE YIELD AND ECONOMICS OF CHICKPEA IN BIKANER DISTRICT OF RAJASTHAN, INDIA

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Abstract

Chickpea (*Cicer arietinum* L.) is a highly nutritious grain legume crop and is widely appreciated as health food as well as high return crop. It is the major pulse crop used in the diet of vegetarian in India and it is a good source of protein. The present study was conducted by Krishi Vigyan Kendra, Lunkaransar in Bikaner district during *rabi* season of 2013-14 to 2017-18 to assess the impact of frontline demonstrations on productivity of chickpea crop. Total 183 front line demonstrations were conducted on chickpea in 84 ha by the active participation of the farmers with the objective of improved technologies of chickpea production potentials. The improved technologies consist improved variety (GNG-1581), seed treatment, seed rate, timely sowing, balanced fertilizers application and integrated disease and pest management, *etc*. Study revealed that improved cultivation practices resulted in increase in yield in chickpea crop over the check plots. The improved technologies gave higher yields and recorded a mean yield of 20.80, 11.5,18.6,17.6 and 16.08 q/ha chickpea yield during 2013-14, 2014-15, 2015-16, 2016-17 and 2017-18, respectively which was 39.60, 27.78, 57.62, 30.65 and 23.7 percent higher compared to prevailing farmers practice. The demonstrated field gave higher benefit: cost ratio of 2.91, 1.89, 3.83, 2.20 and 2.60 compared to the local checks 2.22, 1.69, 2.74, 1.90 and 2.30 during 2013-14, 2014-15, 2015-16, 2016-17 and 2017-18, respectively. Present results clearly show that the yield and economics of chickpea can be boost up by adoption of recommended technology.

REMOVAL OF BASIC FUCHSIN DYE BY DRIED LEAVES OF SUNFLOWER (*HELIANTHUS ANNUUS*)

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Abstract

Water resources are increasingly getting contaminated day by day due to the ignorance given to the wastewater management. Most of the textile dyes or effluents are a major reason for the pollution of water resources. Although many methods are adopted to treat textile effluents, but there is a dire need to come up with an eco-friendly, cost effective method for the removal of contaminants from the effluents. Various plant biomasses can be put to use for the removal of textile dyes from wastewater and make the water clean for various uses. In the present study, adsorption of Basic Fuchsin Dye by dried biomass of sunflower (*Helianthus annuus*) leaves was investigated. 20 mg and 40 mg dried leaves of sunflower mixed with 50, 100, 150 and 200 ppm concentrations of Basic Fuchsin Dye for 10 minutes (contact time). Maximum adsorption capacity by 20 mg dried leaves with respect to different concentrations of Basic Fuchsin Dye was observed as 55.32%, 62.32%, 51.50% and 43.62% at 50ppm, 100ppm, 150ppm and 200 ppm while 59.26%, 64.23%, 53% and 47.29% at 50ppm, 100ppm, 150ppm and 200 ppm respectively by 40 mg dried leaves of sunflower. 40 mg dried leaves biomass of sunflower, found overall much better, in dye removal as compare to 20 mg dried leaves biomass. Adsorption Isotherms studies indicates that Langmuir model was more suitable for describing the sorption of Basic Fuchsin Dye by dried leaves of sunflower.

WEB STANDARDS AND SPECIFICATIONS FOR LIS PROFESSIONALS : A SPECIAL REFERENCE TO W3C

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Abstract

Web standards are formal, non-proprietary and other technical standard specifications that describe the elements of the WWW. The primary activity of W3C is developing protocols and guidelines to ensure long-term growth for the Web. In this paper the authors focus on the popular standards and specification used by the LIS professional and its impact on LIS fields. The W3C is a gateway for providing the detailed process and previews of the standards. Under this gateway the number of standards how it will work for get better result. This article also highlights the purpose and use of the important web standards and specifications.

ORGANIC FARMING IN CORIANDER-RADISH SEQUENCE

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Abstract

During the year 2017-18, trial on organic farming in coriander-radish sequence was conducted under AICRP on vegetable crops at RARI, Durgapura (Jaipur) in *Rabi* season to assess the impact of different combinations of conventional fertilizers and biofertilizers on yield of coriander-radish sequence. The experiment was consist of 8 different treatments having conventional practices and other biofertilizers along with IIHR microbial consortium

individually as well as in combination with each other. The maximum radish root yield (kg.) and coriander leaf yield (kg.) *i.e.* 181.7 and 99.1 kg. respectively was found under treatment T*i.e.*Safe production practices + (Recommended FYM + Fertilizers + Plant Protection + IIHR Microbial Consortium @ 12.5 kg).

COMBINING ABILITY STUDIES FOR GRAIN YIELD AND YIELD COMPONENTS USING BIOFORTIFIED RESTORERS IN PEARL MILLET (*PENNISETUM GLAUCUM* (L.) R. BR)

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Abstract

Two A_1 CMS sources (ICMB-94111 and ICMB-94555) were crossed with 12 biofortified restorer lines in a line × tester fashion to elucidate the information on the combining ability for seed yield and its component traits. A total of 24 crosses were evaluated for eight different quantitative traits. Among the two lines used in the study, ICMB 94555 exhibited significant gca effects for most of the characters studied and was found to be the good combiner. Likewise, among testers Fe & Zn-41 was found to be good general combiner followed by Fe & Zn-21 and Fe & Zn-7-2 for most of the traits under observation. The estimates of variance components revealed predominance of non-additive gene action for most of the characters studied.

MANAGEMENT OF TOMATO ROOT KNOT NEMATODE DISEASE THROUGH INTEGRATED APPROACH UNDER FIELD CONDITION

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Abstract

A field experiment was carried out to evaluate bio-agent- *Pecilomyces lilacinus*, VAM, organic amendment-Neem cake and cultural practices- inter crop with marigold as management practices, for their efficacy against *Meloidogyne incognita* on Tomato, along with Carbofuran 3G as chemical check. The results of the trial on efficacy of different treatments on crop and nematode parameters viz., Plant height, root length, fruit yield per plot and number of galls/root system. Among the treatments maximum plant height at 45 and 90 DAP (69.25 and 86.14 cm), root length (16.43 cm) and yield per plot (19.05 kg/plot) was recorded in combinations of treatments(T_6) Seed treatment with *Pecilomyces lilacinus* @5gm/Kg seeds + Carbofuran 3G @ 3gm/plant at the base + Inter crop with Marigold (2:1) + VAM @50 gm/m^2 + Neem cake @200 kg/acre, as compared to untreated control (51.00 and 76.66 cm), (7.14 cm) and (11.74 kg/plot) respectively. Minimum number of galls 59.25 galls/root system, against untreated check (115.00 galls/root system) was recorded from the treatment T_6.

EVALUATION OF BRINJAL GENOTYPES FOR YIELD AND QUALITY TRAITS IN NORTHERN DRY ZONE OF KARNATAKA

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Abstract:

A field investigation was carried out to evaluate yield and quality traits in 17 genotypes of brinjal (*Solanum melongena* L.). The study revealed that highly significant differences were observed for all the traits. Selection of suitable genotypes is an important criteria for success of crop improvement programme. Growth parameters like plant height, plant spread, number of primary branches per plant and stem girth at 90 days after transplanting was

observed in genotypes G-11 and G-15. Whereas, earliness parameters such as days to first flowering, days to 50 % flowering and days to first fruit maturity was recorded in genotype G-6 and yield performance and quality characters such as fruit length, fruit diameter, fruit length-diameter ratio, average fruit weight, number of fruits per cluster, number of fruits per plant, total yield per plant, total yield per plot, yield per hectare and phenol content were noticed in genotypes G-1, G-2 G-10, G-11 and G-16. Thus, there is an ample scope for direct selection of these traits for improvement of yield per plant. From this study best genotypes have been indentified from the experiment with respect to growth, earliness, yield and quality traits of genotypes like G-1, G-2, G-6, G-10, G-11, G-15 and G-16. Stability of these genotypes can be assessed and utilized for further breeding for improvement of fruit yield and quality characters.

INFLUENCE OF PGR'S AND OSMO-PROTECTANTS ON GROWTH AND YIELD OF BT. COTTON UNDER MOISTURE STRESS MANAGEMENT

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Abstract

The role of different osmo protectants in plant tolerance to drought stress is significant because they regulate multitude of metabolic processes. The present study was therefore conducted to investigate the influence of foliar application of different PGR's and Nutrients, on morpho-physiological parameters for enhancing the productivity in Cotton under stress and unstress condition. The experiment consisted of eight treatments applied under both the conditions which are 2% urea, 2% KNO3, 1% Thiourea, Salicylic acid @ 50ppm, Glycine Betaine @ 100ppm, Salicylic acid @100ppm and PPFM 1%. Among all the treatments foliar application of KNO3 at weekly interval of four sprays after 50% flowering recorded significantly highest plant height, monopodial, sympodial, no. of bolls per plant, total dry matter production and boll weight per plant under stress condition as compared to unstress. Also 2% KNO3 application recorded highest seed cotton yield (1970.3kg/ha) under stress condition as compared to other treatments and unstress (1558.1 Kg/ha) and it was on par with Glycine Betaine @ 100 ppm single spray at 50% flowering (1838.7 Kg/ha) under stress condition.

IMPACT OF SKILL TRAININGS ON SHEEP AND GOAT FARMING

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Abstract

Livestock provides livelihood to two-third of rural community and also provides employment to about 8.8 per cent of the population in India. India has vast livestock resources. Livestock sector contributes 4.11 per cent GDP and 25.6 per cent of total Agriculture GDP. Livestock farming gives way to a profitable enterprise. It is very easy to say but developing entrepreneurs out of farmers and unemployed youth from disadvantaged categories is a challenging task. Entrepreneurship deals with knowledge and skill about the enterprise and its technical details, knowledge about techniques of enterprise management, market information and above all inculcation of entrepreneurial traits. A proper mix of the different components viz. entrepreneurial behavior, technical competence, enterprise management and marketing is required for development of livestock entrepreneurs. Among the different livestock enterprises sheep and goat rearing is one of the most preferred enterprise in dry zones. In Vijayapura district it has been gaining utmost importance and even the unemployed youths with a good qualification also are showing interest in the stall fed rearing of sheep and goats. In this regard, the skill trainings are being given from Krishi Vigyan Kendra, Vijayapura to farmers, farm women and unemployed rural youths in scientific sheep and goat rearing for better profitability. Since 2017 Krishi Vigyan Kendra has conducted 12 training programs in which 419 were trained in scientific rearing of sheep and goat from different talukas of Vijayapura district. The impact study was carried out from the Basavana Bagewadi taluka of Vijayapura district of

Karnataka. The total sample size comprised of 130 unemployed rural youths aged between 25-35 years old in which 31 per cent of them have started the enterprise. Among these 31 per cent, 12 per cent of trained youths have started construction of sheds and are about to start the rearing of sheep, 14 per cent of rural youths have started goat rearing with 20+1 unit with an average net income of 1.5 lakhs/annum and 5 per cent have started sheep rearing with 100 rams and are earning an average net income of 4 lakhs/annum. This shows that, the sheep and goat rearing is not only a profitable enterprise but also provides employment to the unemployed youths.

INFLUENCE OF DIFFERENT AGROCHEMICALS ON MORPHOLOGICAL, BIOPHYSICAL PARAMETERS AND YIELD OF CHILLI (*CAPSICUM ANNUUM* L.) GROWN UNDER NORTHERN DRY ZONE OF KARNATAKA

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Abstract

A field experiment was conducted at Agriculture college farm Raichur, University of Agricultural Sciences, Raichur, Karnataka to study the influence of different agrochemicals on morphological, biophysical parameters and yield of chilli variety. The experiment was laid out in randomized complete block design with 3 replications during *kharif* season 2018. The experiment consisting of 9 different agrochemicals treatment along with a control. NAA @ 10 ppm showed significantly higher plant height and which is on par with GA_3 @ 10 ppm and brassinosteriods @ 0.15%. The results of number of branches per plant revealed that, NAA @ 10 ppm was the most effective treatment in producing lateral branches 23.43 at 75 DAT. The NAA @ 10 ppm produced 102.64, and GA_3 97.95 at 75 DAT. The maximum leaf area was found in the application of NAA @ 10 ppm (39.43 dm^2) followed by GA_3 @ 10 ppm. The treatment showed significant effect on leaf area and all the treatments induced more leaf area than control. The highest photosynthetic rate (43.73 mol CO_2 m^{-2} s^{-1}) was recorded in NAA @ 10 ppm followed by GA_3 @ 10 ppm. Significantly lower photosynthetic rate (25.13 mol CO_2 m^{-2} s^{-1}) was noticed in control over all other treatments. Among all the treatments NAA @ 10 ppm and GA_3 were recorded the highest transpiration rate 10.19 and 9.95 m mol H_2O m^{-2} s^{-1} respectively. The lower transpiration rate was recorded in control compared to all other treatments. It was observed at 75 DAT where NAA @ 10 ppm exhibited maximum SPAD value (36.57) which is on par with GA_3 @ 10 ppm (35.67) while minimum SPAD values (22.83) in control. Among the treatments, NAA @ 10 ppm recorded significantly higher yield (904 kg ha^{-1}) over all other treatments followed by GA_3 and Brassinosteriods 855 and 847 kg ha^{-1}, respectively. However, the lowest yield (496.67 kg ha^{-1}) was recorded in control.

Our Conference Memory

About the Conference Chairman

CONFERENCE CHAIRMAN

Dr. S.P. Singh, born in Village Jevri, Post Rajbun, District Meerut (U.P.), in 1970 and Graduated in Agriculture with Honors from G.M.V., Rampur Maniharan, Saharanpur (U.P.). He did his Post Graduation in Agricultural Botany, Institute of Advance Studies, Meerut University Campus, Meerut and Doctorate in the same discipline (Ag. Bot.) from C.S.J.M. University, Kanpur. Presently, he is working as Scientist (Plant Breeding) at C.S.A. University of Agriculture and Technology, Zonal Agriculture Research Station, Kalai, Aligarh (U.P.). Dr. Singh is a fellow of SRDA, and member of many other professional Societies, having **21** years of experience in Research and Extension Education Works. **He authored many books** such as Plant Breeding, Agriculture at a Glance, Hand Book of Agriculture (Hindi), Crop Physiology (Hindi & English), College Botany, Environmental Science & Agroecology, Concepts of Ecology etc. He is well recognized Scientist and having more than **300** publications in reputed National and International Journals. Dr. S.P. Singh is also **Editor-in-Chief, Progressive Research-An International Journal & Frontiers in Crop Improvement** (both Journals are NAAS recognized), **Secretary,** Society for Scientific Development in Agriculture & Technology and also **Chief Managing Director,** Astha Foundation, Meerut, working in the field of Science & Education.

He has been awarded as Best Editor and Writer Award-**2006**, Young Scientist Award-**2007**, Dr. M.S. Swaminathan Young Scientist Award-**2009**, Distinguished Scientist Award-**2014**, Scientific Initiator Award-**2014** from Directorate of Rice Research, Hyderabad, Science Leader Award-**2015** From RVSKVV, Gwalior, Outstanding Scientist in Agriculture Award-**2016,** Outstanding Achievement Award-**2016,** Excellence in Research Award-**2017,** Innovative Scientist of the Year Award-**2017** Outstanding Scientist in Agriculture Award-**2018** Before this International conference, Dr. S.P. Singh has already organized five conference at different corner of country, first conference was National symposium on **"Achieving Millennium Development Goal : Problems & Prospects"** at Bundelkhand University, Jhansi (UP) during October 25-26, **2009** under the umbrella of SSDAT, Meerut, Dr. Singh has been acted as an Organizing Secretary. The second was National conference on Emerging Problems and Recent Advances in Applied Sciences : Basic to molecular Approaches **(EPRAAS-2014)** during February 08-09, 2014 at Ch. Charan Singh University, Meerut (UP) again by SSDAT, Meerut in which Dr. S.P. Singh has played his role as an Organizing Chairman. The Third, Conference was Organized by SSDAT, Meerut and Astha Foundation, Meerut at Directorate of Rice Research, Hyderabad on Emerging Challenges and opportunities in Biotic and Abiotic Stress Management **(ECOBASM-2014)** during December 13-14, **2014**. Fourth Conference organized by Astha Foundation, Meerut & SSDAT, Meerut at RVSKVV, Gwalior on Global Research Initiatives for Sustainable Agriculture & Allied Sciences **(GRISAAS-2015)**. Fifth Conference was jointly organized by SSDAT, Meerut & Astha Foundation, Meerut at PJTSAU, Rajendranagar, Hyderabad, Telangana State on Innovative and Current Advances in Agriculture & Allied Sciences **(ICAAAS-2016)** during December 10-11, 2016. Sixth Conference organized by Astha Foundation, Meerut in collaboration with SSDAT, Meerut, MPUAT, Udaipur; CSAUAT, Kanpur; UAS, Raichur at MPUAT, Udaipur, Rajasthan on Global Research Initiatives for Sustainable Agriculture & Allied Sciences **(GRISAAS-2017)**. Seventh Conference organized by Astha Foundation, Meerut in collaboration with SSDAT, Meerut, CSAUAT, Kanpur; IGKV, Raipur; BAU, Sabour; MPKV, Rahuri at RARI, Durgapura, Jaipur on Global Research Initiatives for Sustainable Agriculture & Allied Sciences **(GRISAAS-2018)**. Eight Conference organized by Astha Foundation, Meerut in collaboration with SSDAT, Meerut, CSAUAT, Kanpur; IGKV, Raipur; BAU, Sabour; MPKV, Rahuri at NAARM, Hyderabad, Telangana on Global Research Initiatives for Sustainable Agriculture & Allied Sciences **(GRISAAS-2019)**.

Glimpse of SSDAT & Astha Foundation's Conferences

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